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THE Journal of the Society of Arts, AND OF THE INSTITUTIONS IN UNION.

111TH SESSION.]

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Announcements by the Council.

ORDINARY MEETINGS.

Wednesday Evenings at 8 o'clock.

MAY 17.—"On the Manufacture of Encaustic Tiles and Ceramic Ornamentation by Machinery." By ZERAH COLBURN, Esq.

MAY 24.—"On the Development of the Trade with India, and the Bombay International Exhibition of 1866." By J. FORBES WATSON, Esq., M.D.

CANTOR LECTURES.

The Third Course for the present Session, consisting of six Lectures, "On Some of the Most important Chemical Discoveries made within the last Two Years," by Dr. F. GRACE CALVERT, F.R.S., F.C.S. (Corresponding Member of the Royal Academy of Turin; of the Société Industrielle de Mulhouse; of the Société Impériale de Pharmacie de Paris, &c.), will be concluded on Tuesday evening next, at Eight o'clock, as follows:—

MAY 16TH.—LECTURE 6.—On the Discoveries in the Chemistry of Metals and Alloys.

These Lectures are free to Members (without ticket), and every Member has the privilege of admitting ONE Friend to each Lecture.

Proceedings of the Society.

DWELLINGS FOR THE LABOURING CLASSES.

The Committee appointed by the Council to consider this subject* have made the following report:—

The consideration of the best means of improving the dwellings of the labouring classes has for some time engaged the attention of the Society of Arts. In February,

1860, Mr. Twining undertook to collect information, both financial and sanitary, with regard to the efforts *then being* made for providing improved dwellings in town and country. The result of his inquiry was a large and important collection of statistics, which are now deposited in his museum at Twickenham. In order to reduce the information thus collected into a shape which might be useful in future efforts of a similar nature, a special committee was appointed by the Council on the 4th of November, 1863. The report of this committee, which has been printed and circulated, was prepared by Mr. Rigby, with the assistance of Mr. Twining. It contains a concise account of the various blocks of dwellings and renovated houses for families and single men in the metropolis and suburban districts, under the management of societies established for improving the dwellings of the labouring classes, or of individuals interested in the same subject, together with a statement of the primary outlays, annual receipts and expenditure, and other particulars, of these various buildings, arranged in a convenient tabular form.

With a view of eliciting further information on this important subject, the Council invited the attendance of all those who were interested in the movement to a conference on the 26th May, 1864, and on the following day. A large number of those who had taken a leading part in providing better dwellings for the labouring classes, both in London and the country, attended the conference, and much interesting discussion took place. It was strongly urged upon the Council by this meeting to form a committee, for the purpose of taking the whole subject into consideration, and in particular for considering in what way the Legislature could promote the erection of proper and sufficient dwellings for those classes who are so much in need of them.

The Council accordingly, shortly before Christmas, 1864, issued an invitation to various persons, whose interest and experience in the subject were likely to render their advice valuable. The committee met for the first time on the 22nd December, 1864, and continued their sittings during the spring of this year.

At the first meeting of the committee it was unanimously resolved that it was not necessary to collect facts to establish the unfitness of the greater part of the dwellings of the labouring classes as habitations for respectable and well-conducted families, or to prove that the excessive overcrowding which now exists in such dwellings promotes crime and immorality, harbours disease, and materially lessens the effective power of the working-classes, by injuring their health and shortening the duration of their lives.

* See present Vol. of the *Journal*, p. 145.

Nor was it considered necessary to inquire into the effect produced by these badly-constructed, ill-ventilated dwellings on the poor-rates, or into the amount of discontent which the admitted want of proper dwellings creates in the minds of the working-classes. The committee also recognised the distinction which must be drawn between associations for providing improved dwellings by investments for the labouring classes, the capital for which is subscribed with the double object of obtaining a fair interest on the money advanced, and of elevating the social and moral condition of the working classes, and the regular investment in such buildings by builders who must obtain the ordinary commercial profit on capital used in business. In the first case, a dividend of 5 per cent., with an ample fund to provide for all contingencies might be considered sufficient, whilst in the other case a very much larger return would be required. Considering these facts as fully established, the Committee proceeded to inquire into—

(1.) The causes which appear to retard the erection of proper house accommodation, and the improvement of existing houses, for the working classes in town and country.

(2.) The operation of imperial and local taxation on such dwellings; and the expediency of relieving them from all or a portion of such taxation.

(3.) The effect of the law of settlement and removal of the poor upon such buildings in country districts.

(4.) The probable effect of extending the area of local taxation in town and country.

(5.) The operation of the laws relating to the transfer of real property in small plots, and the conveyance of chambers and *suites* of rooms.

(6.) The operation of the destruction of houses by railways and other local improvements.

(7.) The desirability of facilitating the conveyance of labourers to and from their work by railway.

(8.) Whether the provisions contained in the existing Acts of Parliament, for granting loans for the improvement of estates, might not be extended to the building of cottages, and if so under what special conditions.

(9.) Whether the provisions of the common lodging-house act, and other statutes relating to the public health might not be advantageously extended.

(10.) Whether there are any other means by which the legislature can promote the object in view.

It was at first proposed to divide the subjects between three sub-committees, according to their relation to town dwellings, country dwellings, and proposed legislation, but it was found in practice better to amalgamate the sub-committees, as the subjects referred to each sub-committee were so similar. The following gentlemen attended the meetings: Mr. W. Hawes (Chairman), The Hon. and Rev. S. Best, Mr. D. R. Blaine, Mr. C. B. P. Bosanquet, Mr. C. S. Barker, Mr. Edwin Chadwick, C.B., Mr. G. R. Burnell, Mr. H. Cole, C.B., The Right Hon. W. Cowper, M.P., Mr. J. B. Denton, Mr. J. Dillon, Mr. H. B. Farnall, Mr. P. Le Neve Foster (Secretary of the Society of Arts), Professor Fawcett, Mr. C. Gatliiff, Mr. G. Godwin, F.R.S., Dr. Greenhill, Mr. T. Hare, Mr. H. Harwood, Mr. E. T. Holland, Mr. C. Wren Hoskyns, Mr. H. Maynard, Mr. H. Pownall, Mr. S. Redgrave, Mr. B. Shaw, Dr. E. Smith, F.R.S., Mr. S. Teulon, Mr. T. Twining, Mr. G. H. Walker, Mr. Alderman Waterlow, Mr. G. F. Wilson, F.R.S., Mr. T. Winkworth, Mr. J. Young; and Mr. M. Ware, who acted as Secretary to the Committee.

Various resolutions were passed with respect to the questions considered by the committee, the recommendations of which are embodied in this report.

IMPROVED DWELLINGS FOR LABOURERS NOT REMUNERATIVE.

It was shown that labourers living in the metropolis and other large towns pay a larger proportion of their income for rent than any other class in the country, and even then are unable to obtain suitable accommoda-

tion. The immediate cause of this state of things, in places where the law of parish settlement does not cause an additional difficulty, is the fact that providing such dwellings for labourers has not been found commercially remunerative. The efforts of societies and benevolent individuals are every year becoming more extensive, and from the beginning have been appreciated by the industrious classes. They have already accomplished a great amount of good, and have set an example which, it is hoped, will be more extensively followed; but it will be long before the existing evils can be more than slightly mitigated by such means. At present the dwellings provided in this manner in the metropolis only accommodate about 7,000 persons, and the commercial results are not such as to encourage builders and capitalists to undertake the building or renovation of dwellings for labourers as an ordinary matter of business. It appears, from the statistics collected by the Society of Arts, that it rarely happens that such undertakings produce a higher dividend than 5 per cent. on the original outlay, and that in most cases the returns are smaller. This rate of interest may be expected to satisfy a large number of capitalists, who are willing to accept a moderate return upon capital when connected with such important philanthropic objects, but it can hardly be expected that dwellings will be provided in anything like sufficient numbers until they can be made to produce such a return as will compensate a builder for investing his capital in this kind of property, attended as it is with so much more risk and trouble than houses of a superior class.

The difficulty of remedying this state of things is aggravated by the fact that the wretched houses which too many of the labouring classes now inhabit are, in their present condition, highly remunerative to the landlords. Consequently such houses fetch a high price when brought into the market. They may be made to yield a good profit in the hands of those who care nothing for the moral and physical well-being of their tenants; but the expense of putting them into proper sanitary condition, and adapting them to the wants of respectable working-men, reduces the returns so much as to render the undertaking, in a commercial sense, unprofitable.

It may be here remarked that the reproach which has been sometimes brought against societies established for providing improved dwellings, that they consider only the wants of the higher class of labourers, is not now deserved. Several societies have now under their management both blocks of buildings and renovated cottages, in which the poorest labourers are accommodated in single rooms at weekly rents of 1s. 3d. to 2s. 6d. The effect of this is to bring the societies into closer competition with the class of landlords before spoken of.

Some of the causes which tend to render such property unremunerative are beyond the control of any interference, as, for instance, the increasing value of land and buildings in the great centres of industry and the excessive wear and tear of buildings inhabited by poor tenants. The other causes may be classed under two heads—1. Those which may be removed or modified by the legislature. 2. Those which must be remedied, if at all, by increased care and experience in the purchasing of sites, and in the erection of buildings, and in the placing them under economical and efficient management.

The Committee at the outset of their deliberations determined to direct their attention principally to the first of these two classes, with the hope that they might be able to suggest such amendments of the law as would secure to capitalists investing money in this kind of property a fair return on their capital.

Among the burdens which press upon the owners of houses or blocks of dwellings for the labouring poor are the following:—

RATES AND TAXES.

It has been commonly put forward, and is very gene-

rally supposed, that the amount of taxation, local and otherwise, to which property of this kind is subject, is so large as materially to affect the returns which a capitalist or builder would calculate upon as remunerative when contemplating the erection of dwellings for the labouring classes.

It appears to your committee, after investigating the accounts connected with a considerable number of such dwellings, that the total amount of taxation from all sources does not exceed $1\frac{1}{2}$ per cent. on the whole capital invested, an amount which (even if the exemption from the whole of such taxation were practicable) is too small to exercise any appreciable influence on those contemplating the investment of capital in an undertaking of this nature. Under these circumstances, and considering the violation of sound principles involved in making any exemption in favour of any particular class of house property, the Committee do not feel justified in proposing the adoption of any measure of exemption.

The house duty may be usually avoided in blocks of buildings whose size would otherwise make them liable to it, by giving to each set of apartments a door opening to the external air, and making them thereby a distinct tenement. This is called the external gallery system.

PARISH RATING IN THE COUNTRY.

The question of charging the relief of the poor on the parish or on the union, is one which peculiarly affects the building of cottages in the country. The present system has long been found one of the greatest obstacles to the proper accommodation of labourers on the estates on which they work; and the committee were prepared to recommend an amendment of the law by the extension of the chargeability of the poor from the parish to the union. It is a gratification to the committee that the same views on this important question have been generally recognised by the legislature, and that they are likely to be carried into operation by the Bill now before Parliament. The committee confidently expect that many good results will follow from the adoption of that measure.

PARISH RATING IN THE METROPOLIS.

It was a subject of consideration by the Committee, whether similar good results would not be produced by extending the area of chargeability in the metropolitan districts. In the discussion of this question the committee were much aided by statistical tables furnished by Mr. Farnall, and by his large experience in this subject. It appeared from these tables, in which the amount of the poor-rates were reckoned according to their proportion to the gross rental, instead of on the present capricious system of assessment, that the pressure of the rates on property in the metropolitan parishes is not so unequal as is generally supposed; and in the opinion of the committee the inequality which really exists does not in any perceptible degree form an obstacle to the erection of dwellings for the labouring poor. Whatever other causes, therefore, may exist to render it desirable to extend the area of chargeability in the metropolis, the committee do not think that such extension will produce any sensible effect in furthering the object specially under their consideration.

STATE OF THE LAW OF REAL PROPERTY.

Some very interesting discussions took place on the difficulties the present state of the law of real property interposes in the way of those who are desirous of providing dwellings for the labouring poor, and of labourers who wish to become the owners of the dwellings in which they reside.

Much of the land in London and other large towns belongs to Charities and other Corporations and persons under disability, or is in strict settlement. Much has been done by modern legislation towards enabling trustees of settled estates and limited owners to grant building leases, and to sell portions of the estate for the benefit of

the rest, under the direction of the Court of Chancery. But, independently of the expense of an application to the Court, there are many cases which are not met by these enactments.

The Committee suggest that corporations, limited owners, and persons under disability should have similar powers of selling small pieces of land for improved dwellings for labourers as they have now for selling sites for schools—(under the 4 and 5 Vict., c. 38, &c.), and for literary and scientific institutions, under the 17 and 18 Vict., c. 112).

The Committee had the advantage of the presence of Mr. Hare to explain his scheme for encouraging the investment by labourers of their savings in the purchase of sets of rooms in large blocks of dwellings. He proposes that each block of dwellings should be registered under the Land Registration Act, and should obtain a certificate of indefeasible title; that when that is done, the building should be withdrawn from the ordinary laws and incidents of real property, and should become personal estate; and that the apartments in it should be transferred as separate tenements, in the same manner as stock is transferred in the public funds. In this way he hopes that the tenants would become absolute owners of the rooms in which they live, paying off the purchase money in a limited period by instalments, very little greater in amount than their rent as weekly tenants. He also proposes that the management of the entire building should be vested in a committee chosen from the owners of rooms, who would regulate their mutual rights and liabilities, and enforce the good preservation and repair of the rooms and the orderly conduct of the inhabitants.

The Committee agreed in the expediency of any mode of facilitating and cheapening the conveyance of small tenements, but they considered that the difficulties and embarrassments, both to seller and buyer, which would arise out of any plan by which the apartments in a large block of buildings would become vested in individuals of the labouring class, would outweigh any benefit which might arise from it. The danger of such small tenements falling into the hands of speculators, who might take advantage of the necessities of the original owners; the obligation under which the working classes live of continually and suddenly changing their residence in search of work, the probability that the rooms would not be so well kept as when owned by a company; and the difficulty of arranging the mutual interests of so many small independent freeholders, seem to the Committee insuperable objections to the scheme.

At the same time there appears to be nothing in the present state of the law to prevent a company owning such a block of dwellings, after they have obtained an indefeasible title, from letting the sets of rooms as separate tenements on leases of any duration, subject to proper sanitary arrangements; and the Committee believe that such a plan might, in many cases, be desirable. In such a case, the tenant would secure the benefit of a lower rent than if he were a weekly tenant, and would acquire the feeling of property in his own home; while, at the same time, the company would be secured by covenants and powers of entry against dilapidations and misuse of the tenement.

LOANS BY GOVERNMENT.

Numerous Acts have been passed, commencing with the 57 Geo. III., c. 34, for enabling the Public Loan Commissioners to advance money at a low rate of interest for public works and the employment of the poor, the money borrowed being repaid by instalments in a limited period. The 9 and 10 Vict., c. 79, is the Act which regulates the present practice. By the 23 and 24 Vict., c. 19, the Public Works Acts (Ireland) were extended to authorise the advance of money for building cottages for labourers in that country. In England the Public Loan Commissioners have never been authorised to advance money for that purpose; but by

the 9 and 10 Vict., c. 74, they are enabled to lend money to vestries on the security of the rates for building public baths and washhouses. By the 14 and 15 Vict., c. 34, the same Commissioners are also empowered to lend to boards of health, and other local authorities, in like manner, money for building lodging-houses for the poor; this Act, however, is encumbered with so many conditions that it has been practically inoperative.

There is also another series of Acts (9 and 10 Vict., c. 101, &c.), enabling the Inclosure Commissioners to advance money in the same way to landowners for drainage and improvement of land; and under the Private Advance for Drainage Acts (27 and 28 Vict., c. 114, &c.), tenants for life, and other limited owners, can borrow money from private sources for the same purposes. The Inclosure Commissioners appear to have no power to advance money for building cottages, but this may be done by the Drainage and Land Improvement Companies.

So far, therefore, as relates to cottages in the country, the committee do not desire any alteration in the law, but they recommend, with respect to labourers' dwellings in towns, that the public Loan Commissioners should have power to advance money at a rate of interest not exceeding $3\frac{1}{2}$ per cent., for building such dwellings, with due regard to sanitary arrangements. The committee believe that by such assistance the promoters might be enabled to add materially to their profits, and that the building of such dwellings would thereby be much encouraged.

DEMOLITION BY RAILWAYS, &c.

The effect of the demolition of the homes of the poor by local improvements and by metropolitan railways has been lately very much before the public. In the Earl of Shaftesbury's speech on the 31st March, in moving for an amendment of the standing order of the House of Lords upon this subject, his lordship stated that the houses for the demolition of which notice had been given under the bills before Parliament in the present session, amounted to 3,500, containing a population of 20,000 persons.

Although a large number of these houses will not be actually destroyed, being merely included within the limits of deviation, yet the numbers give some, though an imperfect, idea of the vast amount of inconvenience and distress such works must produce among the poor. It has been proved, by careful inquiries on similar occasions in former years, that a very large proportion of those who are displaced do not leave the immediate neighbourhood, but crowd still more the already over-crowded dwellings of the same parish. And, in most cases, the Committee believe that this is not merely a temporary evil, because the necessity of being near their work forms an obstacle to their dispersing into more distant places.

It is the opinion of the Committee that where public companies destroy houses inhabited by the working classes under compulsory powers, they ought to be compelled to provide sufficient improved dwellings within a convenient distance for the same classes in place of those destroyed, and that they should have special powers given them for that purpose.

An evil is likewise sometimes perpetrated by railway companies, though probably to a comparatively small extent, by taking the yards or back premises of houses and reselling them for occupation by labourers, with reduced sanitary accommodation. The Committee are of opinion that in such a case the company should not be allowed to sell such houses without making provision for their proper ventilation and for the sanitary accommodation of their inmates.

WORKMEN'S TRAINS.

Another plan for relieving London of some part of its overcrowded population is to encourage labourers and their families to live a few miles out of London, and to trans-

port them to and from their work in the morning and evening by cheap trains. The number of small houses now building in the suburbs of London is very great, and as working men discover by experience the advantages arising from improved health to themselves and to their families from living away from the crowded streets where they now lodge, the demand for them must increase; but even this improvement will be but temporary, and will shortly produce a new set of evils, unless the erection of these houses be carefully watched and their drainage, ventilation, &c., be properly attended to. Precautions against overcrowding will also be as much required as in existing houses. The Metropolitan Railway Company have been trying the experiment of running workmen's trains for some months with marked success. They provide early trains from Paddington and from the City, which are used almost exclusively by working men, and they allow them to return by any train in the afternoon. No inconvenient restrictions respecting tickets are imposed, and the weekly increase of numbers is very satisfactory, and when the system is extended to Hammersmith still better returns may be anticipated. The London, Chatham, and Dover Railway Company have done the same, in pursuance of a clause in their Act, since the beginning of March. From a statement by Mr. Forbes, the general manager, in a letter quoted by Lord Shaftesbury, in his speech before referred to, it appears that the number of workmen carried by their trains has increased week by week; but the unnecessary restrictions imposed by this company upon the men using these trains must be removed before the low rates will be profitable to the company, or available, to any important extent, to workmen.

The Committee desire to express their decided opinion that it would be for the benefit of the community at large that all the metropolitan railway companies should provide cheap means of transit, at convenient times, for labourers; but they hesitate to recommend that this should be made compulsory in all cases, believing that if their views of the results likely to arise from such accommodation to the working classes be correct, the directors of the railway companies will not fail to adopt them.

There is also another view of the subject which must be noticed by the Committee, namely, the tendency of manufacturers to remove their works from the crowded centres of large towns to suburban districts. Such a practice is likely to produce very beneficial results. While healthier dwellings are provided for those who work in the manufactories, the overcrowded condition of those who are obliged to remain in the heart of the cities will be proportionally relieved.

ENFORCING THE SANITARY LAWS.

Whatever progress may be made in building or adapting houses by individuals or societies, the great mass of the labouring population for many years to come must necessarily live in very crowded neighbourhoods, in houses now existing, and not originally adapted to contain several families under one roof.

It is, therefore, of the first importance that the owners of existing houses, inhabited by the poor, should be obliged to provide those sanitary appliances which are required for the preservation of the health of their tenants, and to check, when it occurs, the progress of infectious disease. Long experience has shown that nothing but constant inspection and compulsory measures will meet the carelessness and cupidity of the owners of this kind of property.

The present sanitary laws are comprehensive, and on the whole efficient, although there are some particulars in which the Committee think they require amendment, especially with relation to the inspection of houses let to lodgers, but not now subject to the provisions of the Common Lodging House Act. The provisions of the sanitary acts are not, however, sufficiently known, nor do those who are qualified by intelligence and position to attend to the

sanitary condition of their own neighbourhood interest themselves as much as could be desired in seeing that the powers of the law are put in execution.

The Committee recommend that a concise analysis of the sanitary laws should be prepared, and that the defects of the existing law should be printed and circulated. In this way the attention of men of education and intelligence would be called to the subject, and they might be induced to take part in sanitary work in the neighbourhood in which they reside or carry on business.

In the country districts the sanitary condition of the people is regulated by the Nuisance Removal Acts, 18 and 19 Vict., c. 121 and 23, and 24 Vict., c. 77, and the Local Government Act, 21 and 25 Vict., c. 98; the power being vested in the Local Board of Health, or, if there be none, in the corporations of towns, boards of guardians, or parish vestries, according to the circumstances of each locality.

In the City of London the power is vested in the Commissioners of Sewers, under the Acts regulating the administration of the City.

In the other Metropolitan districts the vestry or district boards are the local authorities for the removal of nuisances, under the Metropolis Management Acts, 18 and 19 Vict., c. 120, and various Amendment Acts.

By the 21 and 22 Vict., c. 97, the powers of the General Board of Health were transferred to the Privy Council, which has a general superintendence of sanitary matters. This branch of their duties is practically exercised by the medical officer of the Privy Council. The committee think that there should be a committee of the Privy Council constituted as a separate department, to which appeals might be made from the local authorities, and whose duty it would be to consider the recommendations dictated by the experience of the district medical officers.

They also recommend that the appointment of proper inspectors of nuisances should be compulsory in all places, so that it should be the duty of such inspectors to report forthwith to the local authorities all nuisances which exist without waiting for the complaint of other persons.

The Committee further recommend that the medical officers of health should be irremovable without the consent of the Privy Council, and that the amount of their salaries should be subject to the approval of the same authority. The duties of these officers, if properly performed, are liable to bring them into collision with the interests of persons having influence in the vestry, and it appears of great importance that their independence of action should be secured.

It appears also to the Committee, that both the Nuisances Removal Acts, and the Metropolitan Management Acts, are deficient in not giving to the local authorities sufficient powers to oblige the builders of houses to make proper provision for drainage and ventilation.

The 29th section of the Nuisance Removal Act (18 and 19 Vict., c. 121), also requires amendment. It gives power to the local authorities to take proceedings against the owner of a house inhabited by more than one family, if it shall be found to be overcrowded; but it leaves in doubt the case where particular rooms in a house are overcrowded, as well as the case of a single family in a small house of one or two rooms. It is however to be remarked that the medical officers find it impossible to interfere as they wish with the overcrowding of houses, because of the difficulty, it should rather be said the impossibility, of the poor finding accommodation elsewhere. In this as in other details of sanitary inspection, over-strictness may become oppression, and aggravate instead of alleviating the hardships of the poor. Until more and better dwellings are provided, and until the labouring classes have learnt more fully themselves to appreciate the blessings of air and cleanliness, no sanitary regulations can be satisfactorily carried out.

The Committee in conclusion recommend to the Council:—

1. That corporations, limited owners, &c., should have increased power to sell land for the erection of dwellings for labourers, under conditions as to proper drainage, ventilation, and sanitary regulations.

2. That the public loan commissioners should be authorised to lend money, at a rate not exceeding $3\frac{1}{2}$ per cent. per annum, for building dwellings for the labouring classes, under suitable guarantees and with due regard to sanitary arrangements.

3. That in all future railway acts, and acts for local improvements, when houses inhabited by the working classes are destroyed under compulsory powers, such companies should be compelled to provide, within a convenient distance, other dwellings in lieu of those destroyed.

4. That the following amendments should be made in our sanitary laws:—

a. That the appointment of inspectors of nuisances throughout the country should be compulsory.

b. That increased power be given to the proper local authorities, to oblige builders of houses to provide adequate drainage and ventilation.

c. That the medical officers of health should be irremovable without the consent of the Privy Council, and that the amount of their salaries should be subject to the approval of the same authority.

d. That houses in which lodgers are taken, especially where particular rooms in a house are overcrowded, should be brought under more efficient inspection.

5. That with the view of extending an accurate knowledge of the powers contained in the various acts relating to the removal of nuisances, the Council is recommended to prepare and publish a concise analysis of the existing law, calling the attention of the educated classes to this important subject, and pointing out how they may, merely by a little attention and exertion, confer most important benefits upon a large mass of working people and upon the country generally.

6. That the Council be requested to take such measures as it may think advisable to bring the first four of these recommendations as soon as possible under the notice of Her Majesty's Government.

(Signed) W. HAWES, *Chairman*.

3rd May, 1865.

TWENTY-SECOND ORDINARY MEETING.

Wednesday, May 10th, 1865; William Hawes, Esq., Chairman of Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Homan, Julius, 85, The Grove, Camberwell, S.

Hunt, Alfred Terrett, 1, Encombe-terrace, Wandsworth-road, S.W.

The following candidates were balloted for and duly elected members of the Society:—

Bean, Alfred W., Danson-park, Welling, Kent, S.E.

Dent, William, 21, Newcastle-street, Strand, W.C.

Gover, William, Italian-villa, Lee-road, Blackheath, S.E.

Hancock, C., 6, St. Germain's-villas, Lewisham, S.E.

The Secretary called attention to a respiratory apparatus, invented by M. Galibert, who was present and showed its action. A description of it will be found at page 440.

The Paper read was—

ON THE ART OF LAYING SUBMARINE CABLES FROM SHIPS.

By CAPTAIN JASPER SELWYN, R.N.

I venture to claim your attention this evening for the purpose of considering a subject, the importance of which, at the present moment, can scarcely be exaggerated.

A renewed attempt is about to be made to connect, by a submarine electric wire, the intelligences and interests of the old world with those of the new, and no enterprise of this age promises so much benefit to the whole human race as the realisation of such a method of instantaneous communication. The subject, therefore, may fairly be considered as one well fitted to interest the members of a society devoted to the cultivation of the Arts—the highest art being that which is calculated to benefit mankind; while, on the other hand, by no other body could the views for which a hearing is sought be more fitly stamped as current coin or repudiated as base metal. But that I am aided by the observations of some of the first mathematicians and the most celebrated engineers—of this or any other country—if I had not secured the direct support of many of the most distinguished members of my own naval service—I should scarcely have dared to advance here what might be stigmatised as crude opinions or ill-considered theories. Yet I feel that I must ask your indulgence if, while asserting some things with the enthusiastic feeling which must animate every officer of my profession who thinks that he may perchance contribute something, however small, to the solution of a great nautical problem, I should fail adequately to explain, in all cases, points where the apparently intuitive knowledge of a seaman leads him confidently to predict results for which to the landsman's mind there seems no sufficient cause.

It will readily be conceded that just as no railway could be constructed with any chance of economy or ultimate success, unless after the most careful surveys and calculations—as, again, any fundamental error in such calculations would deserve the most careful elimination—so in this great work of laying an Atlantic telegraph cable, which is immeasurably more difficult, it behoves us to examine and re-examine the bases on which we are to proceed, and to refuse attention to no suggestion, from whatever quarter it may come, until we are absolutely convinced of its worthlessness.

Among those considerations which, as I hope to show, may most favourably or most fatally influence the success of the delicate operation of laying a comparative thread of electric communication across the Atlantic, the curves described by the cable in sinking may claim the very foremost place. The question first to be solved is—Is the path of the cable during its descent to its ocean bed a straight line, an upward, or a downward curve? Is it an inclined plane? Is it a parabola with a small curve of contrary flexure? Is it, or when is it, a catenarian curve?

As no less an authority than Professor Airy has held and published the last-mentioned opinion, I will, if you please, consider that case first. A ship at rest in an ocean of two miles in depth, allows a sounding line, carrying an iron weight of 96 lbs., to run freely to the bottom. By many and accurately made experiments we find its time of descent to be fifty minutes nearly. We may treat it roughly, for our present purposes, as two nautical miles per hour. Now we can by no means expect that any telegraph cable, more especially the present Atlantic (a specimen of which is on the table), could sink at a materially greater rate. More probably it would be considerably longer in reaching the bottom. But we will assume that it sinks as fast. Then, in one hour, a cable which is being paid out without strain, will reach the bottom in two miles depth of water. If, during that hour, the ship has made a progress of only one mile, and the natural acceleration of the descending cable has not been interfered with by brakes, the curve described will inevitably be a catenarian one; and this will be the case whenever, no strain being kept on by mechanical appliances, the rate of sinking of the cable is in excess of the rate of progress of the ship. It is always thus in shallow water with heavy cables; a catenarian curve is there the invariable rule.

Next we will consider under what circumstances the cable will pursue a straight path, on an inclined plane, to

the bottom. If the rate of sinking of the cable be again assumed as two miles per hour, and any rate of speed be given to the ship less than or equal to this, while a strain by brakes is placed on the issuing cable sufficient to prevent acceleration beyond the speed at which it is dragged out of the ship, then the line of descent will be a straight one, or little varying from an inclined plane. But in both these cases we have assumed a speed of ship of two miles only per hour, which in practice would be inadmissible.

We will now pass on to the case in which, as always really occurs in practice, the speed of the ship is materially greater than the rate of sinking of the cable. The cable issues from the ship, still under some strain, at from 20 to 30 per cent. in excess of her speed, which we will call five miles in the hour. That is, in one hour the ship has passed over five miles of ground, two miles of the cable has sunk, and, say, six miles of it has been paid out, or has issued from the stern of the ship. What has become of this? and in what curve, or on what inclined plane, is it now arranged? This, so far, is the real point at issue. I venture to hold that the curvature which under these circumstances takes place is an upward one, of the nature of a parabola, having a small curve of contrary flexure near the bottom, the general convexity being towards the surface. My reasons for this opinion are as follows:—First, whatever may be the speed of the ship, the rate of sinking of the cable can never be increased correspondingly, or, indeed, in any degree. Secondly, the slack paid out, averaging 25 per cent., is very much more than the difference between the horizontal distance, five miles made good in one hour, and the diagonal distance from the surface to the bottom on the same route. And this excess will certainly not be expended in producing a serpentine form, for which there is no possible cause, unless a very large proportion of slack is paid out, but in that upward curve, the cause for which is to be found in the resistance to cutting descent of the fluid through which the cable is moving. The less the sp. gr. of the cable, and the larger its diameter, the longer will be the comparatively straight part of the parabola, and consequently the more cable will be exposed to the effect of lateral surface currents wherever such exist. Indeed, a valid proof that there is a considerable portion of the cable so exposed to currents, and, therefore, that there is such an upward curve, is to be found in the fact that on several occasions the issuing cable was run away with by a comparatively trifling current, making it take an angle with the ship's course. This could not have been the case had only the small portion of cable been exposed to the effects of currents, which would be due to the cable following an inclined plane between the ship and the bottom. This upward curve would also be liable to be produced or increased when there existed a current in a direction opposed to that of the ship's progress, for thus there would be an increased resistance to cutting descent. While I thus attempt to show what is probably the curve taken by the cable, and what are the dangers attendant upon it, how it is produced, and what are its limits, I also wish to point out that, if this be the truth, there is an important advantage which may possibly be realized in case of a breakage of the cable. We all, I am sure, sincerely hope that this may not be the case, but should it occur, with proper apparatus attached to a strong hawser or line, and by steaming, so soon as the signal of rupture was heard, directly across the track previously followed by the cable-laying vessel—her consort, whose station should always be about three miles on the lee quarter, might catch the cable again before it was irreparably gone. I exhibit some apparatus for doing this automatically, and without such assistance; but there will be considerable difficulty in using it, unless by men of great nautical skill.

I propose now to consider the lateral curves, with their effects, which may be made by the cable, owing to surface currents at an angle to the ship's course. If, the ship's course being west, a surface current be entered whose di-

rection is southerly—towards south, *i.e.*—no effect can be noticed on the ship herself until, by astronomical observation, the existence of such a current is evidenced in the difference between the true and dead reckoning position; but it is otherwise with the issuing cable. It may immediately be observed to have deviated from its former line straight astern, and is now carried at a greater or less angle on the port or left-hand quarter; also, the strain shown by the dynamometer and the rate of issue will rapidly increase. Now no more fatal error can be committed by the engineer than to load the breaks, and attempt to resist this. The only remedy is to go faster, steer a current course, and get out of the current as soon as possible, yielding so much to the increased demand for cable as never to bring more than a very small strain on. But it may be objected that, by so doing, an enormous percentage of slack will be lost. It is so apparently, but not really; for, as the current is but a surface disturbance, so soon as the cable in sinking has passed through it, the line in which it is laid follows really the true track of the ship as she is carried by the current, although, while in the current, it is carried in a loop far away to leeward. This is very difficult to explain clearly without a diagram or model, to which I must therefore refer you; but it results from the fact that the cable exposes a very large surface to the lateral action, and is not like the ship forced against it by the motive power. If we conceive a fluid surface like oil floating on water of a certain depth—that this oil is carried laterally at a given rate by a cause which does not affect the water under it; if next we imagine a cord laid over the oil and sinking first through it and then through the water, we shall be able to understand how in the oil the cord may be carried off in a loop, or bight, as it is called by seamen laterally, falling thereafter through the water in the true line in which it is laid. But, of course, this will only be the case where the current has no great depth, for if from top to bottom the whole body of water moved, there must be a uniform lateral curve, just as there is a vertical one owing to the resistance to cutting descent.

It will be useful to remember that the new Atlantic cable, having a diameter of one inch and a quarter, exposes about 633 feet of section per mile, and a two-knot current at 11·8 lbs. per square foot brings a strain upon each mile exposed to it, of over three tons. Now, as in yielding to the set of the current more and more cable will constantly be demanded, and therefore more will be exposed to it (the rate of sinking never being capable of increase), it would at first sight appear that this demand ought to be resisted; and, in the first attempt at laying, there was an instance in which this course was pursued, which, as I should have expected, resulted in the breaking of the cable. I hope that so unwise a proceeding will not be repeated. It should be a rule with those who are laying deep-sea cables, that the maximum allowable strain must never exceed one-fourth of the breaking strain, even where the cable is made comparatively inextensible by the use of longitudinal fibre or wire; but where spirals of iron or steel wire enter into the construction of a telegraph cable, not being in contact with an incompressible core, then no strain sufficient to stretch the copper wire, which is now acknowledged not to be protected from such tension by any spirals,—I say no strain, not even that due to its own weight in any great depth, can safely be borne by it. Again, the rule of the cable-maker ought to be that, his cable being hung freely in air, the weight is to be accurately observed which suffices, not to break it, but to stretch it two per cent., and on no account must more than a half of this be afterwards brought upon it.

If, after accurately calculating the number of pounds of copper per mile which will carry messages a certain distance at a certain remunerative rate, I then subject that wire to any tension which can decrease its area, and do so, moreover, to an uncertain extent, at any place where the wire, although seven-stranded, happens to be unusually soft, I might as well not have calculated, for I cannot

secure the result. Therefore, even one per cent. of stretching is to be avoided if possible. There is no other way of doing this than by adopting either straight steel wires, enclosed in an elastic compound, as in Mr. Macintosh's cable, or less perfectly, but probably sufficiently near inextensibility, by the steel spiral in contact with the incompressible copper conductor of Mr. Allan.

The next branch of my subject to which I will beg your attention is the formation of kinks. The causes for their formation are various, the process of coiling and uncoiling being the first. The means of avoiding those so caused, while securing many other advantages, I have so often brought before the public that it would unnecessarily detain you if I were to do more than point out the model and diagrams of the floating cylinders which I have always consistently advocated. But there are other causes for kinks which might be avoided. No treatment could well be more unfavourable for a telegraph cable than that of forcing it to pass round comparatively small drums from four feet to eight feet in diameter, as brakes under a heavy strain, and none could be found more certain to induce the formation of those kinks which are so much to be dreaded. Now, kinks thus formed may occur under water, after the cable has been lost to sight in the waves, and this will happen most often when the ship is pitching, and so suddenly slacking up the cable which then, not being able to sink faster than it did before—being, in fact, partially water-borne—arranges itself into a curve such as it had when tightened round the drum. The next upward pitch produces a kink which may, if it does not break the cable, yet cause inside the elastic sheath solution of electrical continuity. This recovers itself temporarily at the end of an hour or so, when the strain is taken off by the approach of that part of the cable to the bottom and the ends of the broken copper wire come together again, only eventually to be destroyed by the accumulation of electrical resistance at that point.

Now this can be in part avoided by the use of an elastic connection for the retarding apparatus—I will not call it by the ill-omened name of brake—nor should it be in any way similar to those machines which have been hitherto used for such purposes, but rather like the human hand with the difference that the rubbing surfaces must be rolling surfaces also. By such means there must be established a continual give and take of the cable whenever the ship is pitching heavily, as even the *Great Eastern* may do if she gets a sea on the quarter or bow. It should not be forgotten that the danger of bad weather will, in this instance, be double what it was in the *Agamemnon's* case, because the time occupied by one ship in laying must necessarily be twice as great as when two are employed starting from the mid-Atlantic.

I am sure that every one who is interested in the spread of Ocean Telegraphy, not alone those who are pecuniarily interested, but also that far larger body who feel that the more rapid communication of thought must sensibly influence the happiness of the whole race (and to that body who does not belong?) unite in wishing success to the renewed attempt to unite England and America by an electric cable. Of the advantages to the fortunate company who shall succeed we have often heard; there is little doubt that one year's good work would pay the whole cost. But immediately after such success ocean telegraphy would stride where hitherto it has only crept, and then we all trust that each who has some idea on the subject which would secure diminished risk or cost, will have a fair chance of seeing (if it be really good) his pet project brought into practical use. Now my pet is a drum, not, as you have heard to-night, a small one, but one so large as to have been objected to on that score, and which I have promised you not to beat to-night. But you will not, I am sure, object to my mentioning another pet, of quite a different character. No one deserves more credit in connection with submarine telegraphy, for the money they have

expended and the perfection they have attained, than the manufacturers of insulating substances; and I fully believe that whatever was possible has been done by the India rubber manufacturers for caoutchouc, and by the Gutta Percha Company for their admirable gum. But new materials of hitherto unattainable qualities must make themselves felt in every social want, and the discovery of paraffin, and its power of combining with India rubber in small proportion, bids fair to revolutionize the whole system of insulating cables. Not only is the insulation better, but the inductive capacity is less than the best virgin Para rubber, while, for plasticity and durability, it surpasses any gutta percha. More than this, the price at which it can be manufactured will leave these gums far behind, and its general adoption can only be a question of time.

I will conclude by saying that, in my opinion, there ought to be no difficulty in laying telegraph cables wherever required; that there is no reason whatever for preferring along shore lines, but the contrary; and that if we can only hail the success of the Atlantic cable this year, half-a-dozen more cables will immediately be required. I hope that the questions I have raised here on this occasion will have a value stamped on them by discussion such as my feeble efforts could never give; and thanking you for your kind attention, I trust you will believe that my aim has been and will always be "to assist a known friend in view," in the language of the Articles of War, to the utmost of my power and ability.

DISCUSSION.

Mr. VARLEY expressed his opinion that the cylinder or drum introduced by Capt. Selwyn, for the purpose of laying submarine cables, was the best plan that could be adopted, as the cable was thus subject to less mechanical disturbance than was occasioned by the means usually employed. The merits of Capt. Selwyn's system were, in his opinion, so great, that he wished it every success.

Mr. C. W. SIEMENS said they must all feel much indebted to Capt. Selwyn for having brought this subject so fully and ably before them. He (Mr. Siemens) could not, however, go so far as to say he entirely agreed with him in all his statements. The curve made by the cable while being laid was no doubt a very important consideration in dealing with this subject, and he did not agree with Capt. Selwyn that its form was such as he had described it to be. He thought it was capable of demonstration, that when a ship was proceeding at a uniform rate of speed, and paying out a cable of fixed density, the latter must descend in a direct inclined plane. Capt. Selwyn had stated that the moment the cable left the ship it would commence its downward course, at the rate of about two miles per hour; then, if the ship was going at six miles an hour, the inclination at which the cable would remain would practically be 1 to 3, or if it went at four miles an hour 1 to 2, or if at two miles an hour 1 to 1; so that, unless the velocity of the ship changed, the cable must descend nearly in a straight line. Then came the question why it was found impossible in practice to do without a certain retarding force during the operation of laying. While the cable was, as it were, sliding down the inclined plane, the force exerted was so great that, if it were not resisted, it would cause the cable to run out with such velocity as to produce an immense waste of cable. When it got to the depth of 1,000 fathoms the force with which the cable ran out was very great indeed, and it required to be resisted, otherwise twice or thrice as much cable as was required would be paid out. He thought it was of comparatively little importance what method of paying out was adopted so long as it was a safe one, affording the means of varying the retarding force at will. It appeared to him that the great point was to make the apparatus as simple as possible, so that no kinks or other disturbances could arise. With regard to the measure of the retarding force, that would depend entirely upon the specific gravity of the cable

and the depth. The laying of a heavy iron-coated cable in 2,000 fathoms water was a difficult and critical operation. One of very small specific gravity might perhaps go out nearly in the upward curve described by Capt. Selwyn; and if it did so, although there was no retarding power acting upon it, there would be danger that sufficient slack would not be produced at the bottom. Then came the considerations as to the nature of the bottom. If the cable were laid along a great plateau, then moderate slack was sufficient, but with a precipitous bottom, it was difficult to lay out sufficient slack for the safety of the cable. He would mention a case which came within his own knowledge. A cable had to be laid not far from the Spanish coast, and, according to the soundings previously taken the bottom descended in a slope of about one in four, but it turned out that in reality the shore was very mountainous, and of a volcanic nature. At about eleven knots out at sea, there was a deep valley with precipitous sides. The depth of one edge of this valley was about 700 fathoms; of the valley itself 1,600 fathoms, and of the other edge 900 fathoms, so that the cable was suspended between the two precipices, involving great danger of rupture, which actually did take place shortly after the cable had been successfully laid. In cases where such gulfs were known to exist, the only safe plan was to stop the ship, and allow the cable to run out so as to furnish enough to lie on the bottom at every point, however deep. This was a serious source of danger, against which it was important that every precaution should be taken. Deep sea soundings were not generally taken at sufficiently frequent intervals, and cables were seldom laid in the line of soundings.

Mr. THOMAS ALLAN felt much obliged to Capt. Selwyn for bringing forward this interesting paper on the art of laying submarine cables, but it occurred to him (Mr. Allan) that the solution of that problem involved the solution of another, viz., that of the art of making the cable itself. Cables had been made, and were being made, every day, which, so far as their electric conditions went, were suitable for communication with the other side of the Atlantic. The last Atlantic cable, when constructed and on board ship, did its work well enough; but before it got well to the bottom of the sea its occupation was gone, or it experienced such an amount of deterioration, that after it had lain a short time on its ocean bed, it "gave up the ghost," and ceased to be of any use. His own opinion was, that the first element in a deep sea cable was that its specific gravity should be so low that the apparatus required for the laying of it should be something wholly different from what had hitherto been employed. Up to the present time it was a misnomer to say cables were paid out. They were, in fact, dragged out, and were always kept on the stretch, so that (as had been described by Mr. Siemens) on crossing a chasm they were suspended from one point to the other, at the risk of great injury. Hitherto, the main point in the construction of a cable appeared to have been to enclose the electrical conductor in one of two destructible materials—iron or hemp—or in both together. For his own part, he thought it an absurdity to employ a destructible material like iron to protect an indestructible material like gutta percha. It had happened in the Mediterranean that cables after being laid for a short time had ruptured, probably from having been suspended over a chasm, but if these cables had not been burdened with such heavy materials they would probably have remained so suspended, and no destruction of the electric continuity have taken place so long as the gutta percha remained sound. If a cable of sufficiently low specific gravity were made, the operation of paying it out would be an easy one. It might be pitched out of a ship as a fisherman would throw a line from a reel. There ought to be no strain put on it, and it should be let out at a rate 14 or 15 per cent. faster than the speed of the ship, so that it might find its way to the bottom in its own good time. There was no reason why it should not arrive at the bot-

tom of the sea in the same electric condition as when it left the ship. A shallow water cable was a different thing altogether, and called for a different mode of construction. Results proved that nearly all the cables made of a single conducting wire had been failures, while the multiple wire cables between this country and France and Holland had all been successful, simply because, as shallow water cables, their mechanical construction was correct. Of the 15,000 to 17,000 miles of cable laid up to the present time, there were not more than 4,000 miles in working order, and 2,500 out of the 4,000 were of the type of the present Atlantic cable; but that type of cable, wherever it had been attempted in deep water had failed from the stretching. He very much regretted, notwithstanding the experiments instituted by the Government commissioners, that that form of cable had been decided upon for the Atlantic route. The same type of cable had been adopted from Toulon to Algiers and Corsica, and both had failed. In the first place there was considerable difficulty in laying it, and though it was made of comparatively low specific gravity, so as to make it suitable for deep water, it kinked to a great extent. The late Atlantic cable was of such a construction as to be liable to stretch, and that impaired its conducting power. He sincerely hoped the present cable would be successful, but he could not say he had much confidence in it—many causes might rupture it before it got to the bottom, and even if it arrived safe there he was afraid it would not satisfy the requirements of the public.

Dr. BACHHOFFNER remarked, with reference to what had fallen from the last speaker, that they had been told by Capt. Selwyn that he believed if the present Atlantic cable succeeded the whole cost of £800,000 would be repaid in one year, but from what had been said by Mr. Allan, who was a great authority on these matters, the failure of that enterprise might be looked for long before the £800,000 was earned. Mr. Siemens, who was a great authority in the laying of cables, differed from some of the statements made by Capt. Selwyn, and had put a very remarkable case before them in support of his own views with respect to the great valleys or gulfs met with at the bottom of the sea. Mr. Allan had spoken in favour of cables of low specific gravity, but he (Dr. Bachhoffner) thought that was hardly the type calculated to withstand the great resistance which a long cable like the Atlantic would meet with. The casing of a cable with iron was desirable—first, for obtaining a certain degree of specific gravity, and secondly, to withstand any injury it might meet with when laid down. There was one circumstance connected with this subject which had not yet been noticed. They were told on the preceding evening in this room, by Dr. Crace Calvert, of the effects that were produced upon iron by friction and percussion, by which a body not crystalline in its natural condition became so by constant motion, and the familiar example of the crystalline state of the axles and tires of locomotives was given in support of that view. Some years ago he was much engaged in manipulations with large voltaic batteries, the wires of which were as thick as a goose-quill, and composed of the best and most flexible quality of copper, but after a few months' use those wires became so brittle that they broke off short like a piece of dry stick. He thought it was generally admitted that the action of electricity through these conductors was a vibratory action, and not a direct transmission of the force. It was by molecular action that electricity was conducted through the wire, owing to which it resulted that the wire became in a short time converted from a fibrous into a crystalline state; and he believed it would be so with the electric conductors in cables, in proportion to the work to which they were subjected, or in proportion to the amount of electricity transmitted; and thus there might be danger that, after long use a very slight accident in the water would easily cause rupture. Capt. Selwyn had mentioned the curious circumstance that a cable in being paid out might be so stretched as to cause an interval between two points of

the conducting wires, but that as the cable contracted again after it was relieved of the strain these would be brought together again. That was alleged to have been the condition of the late Atlantic cable. They knew if there was an absolute break of continuity of the conductor only a small spark would be transmitted from one point of severance to the other, and eventually so much oxidation would take place as to destroy the conducting power of the cable.

Mr. MACINTOSH said he thought that, from the care the electrician was taking in testing the new Atlantic cable in tanks under water, there was no doubt that, when the *Great Eastern* left Valencia for Newfoundland, the electric tests would be perfect. The paying-out apparatus was of an exceedingly delicate character, and he believed a tolerably accurate survey of the bottom had been made, so that he had little doubt but that the cable would remain practically useful for some time at least. The tarred hemp covering would, however, cause great delay in the sinking of the cable, particularly if it met with surface currents. If the *Great Eastern* encountered bad weather, the heaving up of the stern would be great, inasmuch as, if a sea struck her on the quarter, she would not get away from it, simply because she could not travel, during the paying out, at more than six miles an hour; therefore, unless her brakes were very delicate, there must be a severe strain upon the cable. He thought, moreover, that the insulating medium employed was faulty. A microscopic examination of gutta percha showed it to be full of impurities. Those impurities, so long as they remained dry, were non-conductors, but the moment they became hydrous, they were conductors, and hence, he thought, the cable must, after a time, fail. There were, however, compounds such as paraffin, which could be obtained as pure as virgin wax, and the insulating qualities of which were superior to the purest indian rubber. It was, moreover, well known that paraffin was unalterable, that it was unpalatable to marine insects, and that it was exceedingly cheap. If they succeeded in laying this Atlantic cable, expensive as it was, the great demand that would be created for intelligence from across the Atlantic would stimulate others to prepare cables of a more suitable mechanical structure, and he had no doubt there would be four or five cables across the Atlantic within a comparatively short period. He therefore hoped that every judicious step for the success of the present enterprise would be taken by those in charge of it, for it would be a most unfortunate circumstance for the community at large if any mishap took place.

Capt. SELWYN said he had promised not to speak of his cylinder; but he had brought a model of it, in order to illustrate his theory of the curve taken by a submarine cable, as nearly as he could do so without the water. It was quite clear that with a rope or piece of twine he could not fitly represent the resistance due to a body passing through water. He was therefore compelled to resort to a lighter and broader substance, consisting of the riband of paper, usually employed for printing telegrams, wound on to a reel, so as to give a certain per-centage of slack, but nothing like that given in laying out a cable in practice, and as the reel passed from one side of the room to the other, it would be seen that the curve described was an upward curve. There could be no better proof afforded that the resistance over a large surface of cable was something considerable, and that it could not follow, under these conditions, the inclined plane, the existence of which not only Mr. Siemens but other men highly placed in science, would have us believe. He (Capt. Selwyn) brought to bear on this subject his practical knowledge, extending over five-and-twenty years, in the use of ropes and in deep-sea soundings, and he had no hesitation in stating that the result of his experience was a belief in the curve which he had described. [The action of the model of Capt. Selwyn's cylinder was then exhibited by passing it several times across the room upon wires stretched as bearers, and the riband of paper

took the upward curve, as described. Capt. Selwyn then went on to remark that the chairman had informed him that the speed at which the model had travelled in this illustration was as near as possible six miles an hour, and thus it approached sufficiently near to the rate at which a cable was laid in practice. Mr. Siemens, in speaking of the curves, inferred that he (Capt. Selwyn) advocated the doing away with the retarding power over the cable. That was not so. The paddle-wheels of the cylinder were capable of exerting when necessary a very considerable retarding power; as long as the ship towed the cylinder a-head those brakes did not act, unless there was a pull upon the cable, which tended to produce a rotation of the cylinder in excess of the rate at which the ship was travelling, and that rotation was resisted by the beating of the paddles against the water. In point of fact he substituted water-brakes for the mechanical brakes, by which he believed no little mischief was occasioned to the cables that had been already laid. With regard to the precipices in the bed of the ocean referred to by Mr. Siemens, they were told, soon after the laying of the Atlantic cable, that there was a precipice on the shore of Ireland which led to the rupture there. In order to ascertain the matter, he went over the soundings with the late hydrographer, and he found the descent was only 1 in 16, being a little less than Holborn-hill. That there were such precipices as Mr. Siemens had described, in volcanic regions and on rocky coasts, there could be no doubt, but that was a warning to avoid such places in laying a cable, and by proper survey to ascertain that no such places existed along the path on which the cable was intended to be deposited. He had been much engaged in marine surveying, and he would say that any one employed in that work, who left unnoticed such a gulf as that described by Mr. Siemens, deserved much blame. Such a thing could not occur if the most ordinary care was exercised in surveying the ground before attempting to lay a cable upon it, and no engineer should be allowed to lay a cable where a surveyor had not preceded him to ascertain, with the utmost attainable accuracy, the form of the bed of the sea. With regard to the friction of the cable on these precipices (supposing it to have been laid on a badly selected route), he would point out that the heavier the cable was, the more mischief there was from friction; if it were not so heavy as to be incapable of being moved by the currents (a condition impossible of attainment in deep sea cables) then the weight was the most important element in producing damage by friction, having to be multiplied into the velocity of that friction. A cable of the specific gravity of gutta-percha, exposed to friction on a hard rock at the rate of 2,000 movements per minute, for a space of two feet, would last fifty times as long as one with an iron covering in the same situation. Here we had nature going before us. We had her anchoring her submarine vegetation to the stones and rocks in the bed of the sea, and allowing them to trail for long distances, and to be influenced by the ebb and flow of the tides. During that time they were subjected to great friction, but in no instance were they ever cut through, simply because they were not heavy, and the friction which would otherwise have destroyed them did not take place. On the shores of the Falkland Islands, and off Cape Horn, he had seen fucii (the *fucus maximus*) rising from a depth of 60 fathoms to the surface, with trunks as large as many of the oak trees met with in this country, and of such strength that ships which had dragged from their anchors had been saved by getting amongst the branches. They were made like the reed, which would bend to every storm, but more successfully resisted it than the oak. His friend Mr. Allan had happily found out that the making of a cable was so simple a matter that he was inclined to think the laying of it was an equally simple proceeding. On that point he was compelled to join issue with him; but he had no doubt when a cable of such

moderate specific gravity as Mr. Allan advocated was used, there would not be very much difficulty in laying it. There would be no kinks owing to the construction of the cable itself, and there would be much less difficulty in laying it than a spirally-covered cable. Dr. Bachhoffner had spoken of the resistance to friction, and he had already answered that point as far as he was able. With regard to the crystallisation of the conducting wires, that was known to electricians as the burning of the copper wires, and wherever, from the small area of the wire or the too great tension employed, the current was unduly retarded, this effect was produced. With a fine platinum wire the resistance was so great that it was brought to a white heat, and was destroyed under a current which would pass through a given area of large copper wire without resistance or heating. The coils used for magnetic purposes were liable to be heated if a current of too great tension were passed through them. It was a question how far the area of the conducting wires was diminished by mechanical violence below that which had been calculated by the electrician as necessary to avoid such crystallisation as Dr. Bachhoffner had spoken of. With regard to paraffin, which Mr. Macintosh had alluded to, he (Capt. Selwyn) had, in company with more competent persons, closely tested the compound of paraffin and india rubber; and he believed the whole of what had been claimed for it was borne out, so far as the electrical conditions were concerned. The indestructibility of the compound could only as yet be inferred, but paraffin was in itself a substance which, as its name implied, had no affinities, and was not liable to the same process of decay as other substances having those affinities. Amongst those substances he gave the foremost place to iron wire, which oxydised under salt water with great rapidity, but hemp in contact with iron wire was destroyed even more rapidly. The use of tar only slightly retarded the decay. Where the spiral iron wires were surrounded by hemp, the destruction of the latter left them loose round the gutta percha; indeed the iron wire spiral was nothing more nor less than a most insidious enemy to the gutta percha and the copper conductor. Whether as regarded weight, producing friction on the bottom; whether as regarded the destruction of the hemp and the coincident oxydation of the iron wire, producing a number of sharp points which might destroy the gutta percha; or whether as regarded the expense, according to his views, the use of iron spiral coverings for deep sea submarine cables was wholly unjustifiable. He would rather see a simple gutta percha and copper wire cable than such an one. Though by no means saying that such would be the most perfect form, he believed there would be more chance for its durability in deep sea communication if the specific gravity were carefully studied. He was rather disappointed that the mathematical question involved in the curves had not met with a more able exponent than himself during the discussion. He conceived the curve was capable of being reduced to a true mathematical expression of the forces brought into play, and the Atlantic Telegraph Company might derive great benefit from those curves being ascertained before they proceeded with the laying of their cable. He hoped every precaution would be taken, for the interests at stake were very great, and upon the success of the enterprise depended the future of telegraphy, whether it should advance now or half a century hence, for if the present scheme broke down they might say good-bye to telegraphic communication with America, except through Russia, for a long time to come.

The CHAIRMAN said it was now his duty to ask the meeting to give a cordial vote of thanks to Capt. Selwyn for the very interesting paper he had favoured them with. A topic more worthy of discussion could hardly have been brought before them, considering the importance, both in a political and commercial point of view, of facilitating the communication with America. He agreed with Capt. Selwyn that if another £800,000 were lost, a third would

be forthcoming to try the experiment again. It was hardly possible, even if this next attempt failed, but that some further practical experience in these matters would have been gained by the failure, and even if another £800,000 was lost, the question of communication across the Atlantic was of such immense importance to the public that it was worth all this cost. When the commercial public were tired of the question, the governments must take it up. When all the science and all the great professional intellect of the country was being brought to bear on this subject, unless there were some at present unknown physical difficulties in the way, the time could not be far distant when an electric communication between America and England would be completed. Those who had taken part in this discussion had travelled a good deal away from the real subject brought before them, for Captain Selwyn did not open the question as to the merits of the different forms of cable. He (the chairman) thought it was to be regretted that some gentlemen present had expressed so strong an opinion on the merits of the cable now about to be tried under the auspices of eminent men, without having given notice that such a discussion was to arise, and without giving an opportunity for answering the statements so made. He was sorry that this *ex parte* discussion had taken place at a time when the public were looking to the completion of an enterprise fraught with such great results to the community. Nothing should be done to throw cold water upon the undertaking, but rather everything to encourage it. If it failed, those who had supported it would be the sufferers, and we should have to thank them for the experience gained, which might lead others, if not themselves, to a more successful result. There was one other point connected with this subject which he would just touch upon, that was the question of the survey of the bottom of the sea along the course where it was intended the cable should be laid. Many present, no doubt, recollected an occasion when some of the various surveys of the Channel were shown in that room. From them it appeared to have an almost perfectly level bottom; but he had heard it stated that much of this surveying was mere guess-work, and therefore that it was quite impossible, with such soundings, to say accurately what kind of surface was met with at the bottom of the ocean. Capt. Selwyn had, however, informed him that in the case of the Atlantic the soundings were complete and reliable for every ten miles of the whole route to America. If that were so they could hardly anticipate a casualty like that referred to by Mr. Siemens; but in the Mediterranean and other places the soundings might be only ten miles apart and yet there might be intervening rocks or precipices which would tend to injure the cable. He now called upon them to thank Capt. Selwyn for his admirable paper, and for the very lucid manner in which he had explained his views on this important subject.

The vote of thanks was then passed and acknowledged.

Proceedings of Institutions.

EXAMINATION OF SOLDIERS.—The following circular memorandum (Gen. No. 331), addressed to the army at home, has been issued:—"Miscellaneous 1 (1865).—The Field Marshal Commanding-in-Chief desires it to be notified that there will be no objection to soldiers, their wives, and families, being permitted to present themselves for instruction and examination at the Educational Institutes in connection with the Society of Arts, on the understanding that they are not on that account to be exempted from any military duty, nor, except in special cases, to be out of barracks after watch-setting or tattoo.—By command of his Royal Highness the Field Marshal Commanding-in-Chief, JAMES YORKE SCARLETT, Adj. Gen.—Horse Guards, S.W., 11th March, 1865."

NEWCASTLE-ON-TYNE MECHANICS' INSTITUTION.—On Wednesday, the 19th April, Sir George Grey laid the foundation stone of a new building for the Mechanics' Institution at Newcastle-on-Tyne. Several members of Parliament were present at the ceremony. In the evening a public meeting was held, over which Mr. Headlam, M.P., presided. An address of thanks was presented to Sir George Grey for his services at the ceremonial in the morning. Sir George Grey, in replying, referred to the origin of the society, now forty-one years ago. It was established in February, 1824; and its members felt pride in the names of those men under whose auspices it then was formed, and afterwards attained most distinguished eminence, and of which Newcastle and Northumberland were justly proud. To one in particular reference might be made—George Stephenson; and he was sure he only expressed the common wish of all who heard him when he said they earnestly desired that this one name might be handed down to successive generations of thousands worthy of the great man whose fame is identified with this part of the country, and who, amidst all his engrossing occupations and his world-wide fame, never lost the deep interest he took in this institution, because he believed it was calculated to confer inestimable benefits upon the class from which he sprang, and with which he never lost his connection. Another name he would also refer to—that of Lord Brougham, which could never be mentioned without honour in connection with Mechanics' Institutions, for which he had done so much, and in which he still retained the warm interest he ever felt in all that concerned the intellectual improvement of the people. Referring to the changes, political and commercial, which had taken place during the forty years since the institution was founded, Sir George Grey alluded to the repeal of the corn-laws, and the part taken by Mr. Cobden in this beneficial change. One of the greatest proofs of progress was the increase in the means of education. The means of carrying out the education of the working-classes was now extended to a degree which he believed the most sanguine friend of education forty years ago could not have anticipated. Education, however, was a life-long work, and consisted in availing oneself day by day, in the intercourse of ordinary life, of the means of increasing knowledge by reading, reflection, and intercourse with other men. And here it was that Mechanics' Institutes and libraries were found to be so valuable; there were few who had not some time to give to mental culture; but how many were there who had not the means of access to libraries and books from which to derive that instruction which they desired to obtain. Mechanics' Institutions and kindred associations placed within the reach of every individual man those means of education which, isolated and separated from the institution, he could not possibly obtain. In those Institutions a man might avail himself of that knowledge the means of acquiring which he had already obtained in the primary schools. These institutions gave a man an object worthier of his higher nature, and kept him from indulgence in those debasing pleasures which destroyed his domestic comfort, ruined his health, and too often ended in shame, misery, and crime. Would that these advantages were more generally appreciated. He trusted that, in this district, they were so. Referring to the recent differences between the masters and their workmen, he said he believed that the more the influences of these Mechanics' Institutions were extended, the more the means of knowledge conferred by these Institutions pervaded the mass of the people, the less chance would there be of those differences leading to consequences which all must deprecate.

DUBLIN INTERNATIONAL EXHIBITION.

The Exhibition was formally opened by His Royal Highness the Prince of Wales on Tuesday, the 9th inst. His Royal Highness arrived at about half-past two

o'clock, accompanied by the Duke of Cambridge, and attended by the Lord Lieutenant and Lady Wodehouse, Earl Spencer, and Sir Robert Peel, and was conducted to the dais which had been prepared for him.

The National Anthem having been performed, the Duke of Leinster read the following address:—

"To His Royal Highness Albert Edward, Prince of Wales, Earl of Dublin,—May it please your Royal Highness—For the distinguished honour of your Royal Highness's presence here this day, we, the Exhibition Committee, desire to offer our humble thanks. It is difficult for us to give expression to the feelings of joy and loyal satisfaction which fill the hearts of all who throng these halls to witness the inauguration of the Dublin International Exhibition of 1865 by your Royal Highness in the name of our beloved Sovereign. In this mark of favour and approval we discern not alone the Queen's high appreciation of the interests of industry and art, but especially her Majesty's gracious wish to promote the success of every enterprise which tends to advance the welfare of the Irish people. The act which your Royal Highness is about to perform cannot fail to remind us of the enlightened encouragement which the illustrious and lamented Prince Consort bestowed upon every work of usefulness, and especially upon undertakings like the present. International Exhibitions, bringing together the various nations of the earth, and making each better acquainted with the wants and with the resources of the rest, directly tend to stimulate industrial energy and increase commercial interchange, and, binding all people together by the ties of mutual interest, they become in no small degree the auxiliaries of peace and progress. The fine arts now occupy a prominent place in international exhibitions; the display of the best works of renowned artists opens up new sources of pleasure and delight, and forms a most important agent in the education of the people. We trust that the Exhibition at whose commencement your Royal Highness so graciously presides may prove not unproductive of such beneficial results, and that it may justify the hopes of those who, in honest labour and in self-reliant enterprise, recognise the true sources of national prosperity. We cannot conclude without expressing our heartfelt wishes for the health and happiness of your Royal Highness's illustrious consort, whom the Irish people earnestly desire to see amongst them. Whenever circumstances may permit her Royal Highness the Princess of Wales to visit our shores, which we trust will be at no distant period, we venture to promise such an enthusiastic welcome as will convey to her Majesty and to your Royal Highness the fullest assurance of loyalty and devotion."

To this address his Royal Highness was pleased to return the following reply:—

"My Lords and Gentlemen—I thank you for your address. It is a source of sincere pleasure to me to discharge the duty which has been confided to me by her Majesty the Queen in thus inaugurating your Exhibition. It is not less in accordance with my own feelings than with those of her Majesty to assist in every measure which is calculated for the happiness and welfare of the Irish people. The example of my lamented and beloved parent will, I trust, be ever present to my mind as a stimulus to the encouragement of every work which is calculated to advance international prosperity and to develop the resources of my country. The cultivation of the fine arts, in itself so powerful an auxiliary in civilising and refining the human race, has been an important object in this Exhibition, and seems already to have produced most satisfactory results. Believe me to be very sensible of your kind wishes on behalf of the Princess of Wales. Her regret at not being able to accompany me only equals my own; and you may rely on her anxiety to come among you assured of the welcome she will receive."

The Old Hundredth Psalm was then performed, and at its conclusion Mr. Gilbert Sanders, chairman of the

Exhibition Committee, read a report giving a history of the Exhibition Palace.

Mr. Parkinson (comptroller) presented to the Prince the key of the building. The Coronation Anthem was then sung, and at its conclusion an address was presented by the Lord Mayor of Dublin, to which his Royal Highness replied.

The "Heavens are Telling," from Haydn's *Creation*, was then performed, and at its conclusion the procession made the tour of the building. On the return of the Prince to the dais, the opening chorus from Mendelssohn's *Hymn of Praise* was performed. At its conclusion His Royal Highness commanded Sir Bernard Burke, Ulster King-at-Arms, to declare the Exhibition open.

SOCIETY OF ARTS PRIZE COTTAGES.

The following correspondence on this subject has appeared in the *Builder* of the 29th April and 6th May:—

The following is the result of a trial to get cottages built on the plan described in your number of the 31st of December, as having obtained the Society of Arts prize, and as estimated to cost £203 a pair.

The cottages to be built were six in number; the locality was Bishop's Stortford; and the very best means were taken to ensure that the plan and specification should be in strict accordance with the ideas of the designer.

Six tenders were obtained: three from London builders and three from the country. They were—

Perry, Stratford, London	£1,193	or	£397	13	4	the pair
Bell and Sons, Cambridge	1,272	or	424	0	0	"
Glasscock, Bishop's Stortford	1,380	or	460	0	0	"
Freeman and Sons, Ely	1,388	or	462	13	4	"
Patrick and Sons, London ..	1,392	or	464	0	0	"
Hill and Keddell, London	1,581	or	527	0	0	"

So that the lowest tender was nearly twice as much as the estimated cost of the prize cottage; the low estimated cost being, I presume, one of the principal grounds of awarding the prize to it.

Any one can build a good labourer's cottage: the difficulty is to build one for little money. I have had occasion to build hundreds, but could never build one that a decent family should live in under £140 or £150 a single cottage.

ROBERT SINCLAIR,
Engineer-in-Chief, Great Eastern Railway.

With reference to Mr. Sinclair's letter in the *Builder* of the 29th ult., I feel called upon, as the author of the design referred to, to state that the plans and specifications upon which the estimates obtained by Mr. Sinclair were based, were, as indicated in his letter, prepared by me, and embodied not only the improvements and additions suggested by the judges in their report, but also such other improvements as had occurred to me since the preparation of the original design, in order to make them complete in every respect, without special regard to the estimated cost. It cannot therefore be expected that the estimated cost of the original design will bear a favourable comparison with the tenders obtained by Mr. Sinclair for the altered and improved plans and specification furnished to the company.

I may mention that, further than the preparation of the said plans and specification, I was not professionally employed, being quite unacquainted with the locality where the cottages were intended to be erected, and the nature of the site, and had not even heard the result of the tenders until observing Mr. Sinclair's letter.

Unquestionably the tenders obtained by Mr. Sinclair are high. Had a greater number of builders in the immediate neighbourhood, and in a much smaller way of business, been applied to, the result would, I have little doubt, have proved more satisfactory.

I have lately had occasion to obtain several estimates

from local builders for similar cottages which I am now erecting upon an estate on the borders of Kent and Surrey (about nine miles across country from the nearest railway station), the result of which I beg to subjoin:—

R. Ward, Warringham	£312	0	0	a pair.
Kesterton and Head, Lingfield	287	10	0	„
R. Bellchambers, Westerham	285	0	0	„
F. Shorter, Edenbridge	259	18	0	„
G. Crane, Cudham (accepted)	216	0	0	„

These estimates, however, were framed upon a plan and specification embracing the improvements suggested by the society, besides plastering and colouring to walls (not included in my original estimate), but with certain modifications in regard to the offices; *i. e.*, dispensing with the w.c. apparatus, lead pipes, cistern, force-pump, and well, and substituting a rain-water tank, 5ft. diameter and 8ft. deep, with pumps, privies, and cesspool at end of garden, and including the cost of a piggery to each cottage, which, however, has been dispensed with in the tender accepted. Neither the timber for the roof nor the cartage of materials is included in the contract, the value of which, when added to the lowest estimate, will represent a sum close upon £260, the actual cost of the cottages per pair to the proprietor, bearing a favourable contrast with the average cost of good cottages, with similar conveniences, stated in the report of the judges previously referred to.

It will be observed that the locality where these cottages are being built is by no means easy of access; and it may be reasonably inferred, that under more favourable circumstances a considerable saving might be effected in the carriage of materials, an item of much importance in cottage building.

JOHN BIRCH.

ROYAL SCOTTISH SOCIETY OF ARTS.

The above Society proposes to award prizes of different values, of thirty sovereigns and under, in gold or silver medals, silver plate, or money, for approved communications primarily submitted to the Society by fellows or others, relative to inventions, discoveries, and improvements in the mechanical and chemical arts in general, and in their relation to the fine arts, and also to means by which the natural productions of the country may be made more available. The Society suggests the following as a few of the many subjects that may be attended to, *viz.*:—

I. INVENTIONS, DISCOVERIES, OR IMPROVEMENTS IN THE USEFUL ARTS.

1. Mechanical Arts.

Inventions or improvements in applying the motive power of men and animals—in wind and water prime movers—in steam and other heat engines, including gas engines—in pumping, blowing, rolling, sawing, agricultural and other engines and machines—in cotton and other textile manufacturing mills—in ship-building, wood, iron, and steel—in lighthouses—in marine propellers—in railways, plant, and signals—in electro-magnetic motive power—in electric and other telegraphic apparatus, submarine and aerial—in photographic apparatus—in fire-proof buildings—in water-supply—in paving—sewerage—in economical appliances for increasing the sanitary condition of towns—in smoke consumption and extinguishing fires—in gas-works—in canals and inland navigation, including the application of steam-power to canal traffic—canal locks, inclines, and lifts—application of hydraulic power for lifts for domestic use—for cranes—printing presses—organ-blowing, and other similar purposes, where small propelling power is required—labour-saving machines for working in wood—in tools, implements, and apparatus for the various trades—in bricks, encaustic tiles, cements, and mortars—in printing machines, cases, and rollers—in stereotyping—in cranes—in the machinery for collieries—in preserving timber and

metals in marine works—in optical apparatus for astronomy, surveying, and levelling—in manufacture of paper—experiments on the effect of low temperatures on metals.

2. Chemical Arts.

Inventions or improvements in new and useful applications of gutta percha and vulcanised india rubber, or similar gums—in the economical extraction of chemical principles or useful substances, as paraffine, &c., from coal—porcelain clay from granite or felspar—and metals generally from their ores and oxides—in dyes—in paints—in paper—in glass, especially for lenses—in methods of rendering the electric light available in practice.

3. Relative to the Fine Arts.

Inventions or improvements in photographic processes, in “carbon” printing, and in methods of printing photographs from their impressions on steel or copper-plates, or lithographic stones—in electrotype processes—in die-sinking—in methods of illustrating books, to be printed with the letterpress—in paper-hangings—in articles of porcelain, common clay or metal—in glass-staining—in engraving on stone—in chromo-lithography—in “Nature” printing.

4. Natural Productions.

Discovery of plumbago mines—whetstones—of woods suitable for engraving.

II. Experiments applicable to the useful arts.

III. Communications of processes in the useful arts practised in this or other countries, but not generally known.

IV. Practical details of public or other undertakings of national importance, already executed, but not previously published; or valuable suggestions for originating such undertakings.

THE KEITH PRIZE, VALUE THIRTY SOVEREIGNS.

For some important “Invention, improvement, or discovery, in the useful arts, which shall be primarily submitted to the Society” during the session.

THE HEPBURN BIENNIAL PRIZE, VALUE ABOUT £12.

(If not awarded during Session 1864-65.)

“For such inventions or communications submitted to the Society as shall be approved of by the Society, or by their Prize Committee.”

THE MAKDOUGALL-BRISBANE BIENNIAL PRIZE, VALUE £10.

(If not awarded during Session 1864-65.)

“To the authors or inventors of communications of merit, which shall be approved of by the Society, or its committee, and judged by them deserving of such distinction.”

THE REID AND AULD PRIZES.

For the first, second, and third best models of “Anything new in the art of clock and watch making—by journeymen or master watch and clock makers.” If these should be considered worthy of prizes, the year's interest of the Reid and Auld bequest, being about seven guineas, divided among them in such proportions as the Prize Committee shall fix, according to merit. To such as deserve it, the Society may add to the amount of the prize out of its general funds.

By the liberality of Charles Cowan, Esq., of Loganhouse, the president, and his partners, the Council are enabled to offer a prize of fifty sovereigns, with the Society's silver medal, for the best communication, if otherwise approved, on the “Purifying of Water which has been used in the manufacture of Paper.”

The processes employed may shortly be stated to be:—

1. The washing of “filthy rags,” and other fibrous materials, for which a large quantity of pure water is requisite.
2. The boiling of such materials in an alkaline solution, and the washing of the contents of the kiers or boilers in which the boiling operations have been conducted. And

3. The steeping of the half-stuff in chests in a solution of chloride of lime, and the washing of the partially exhausted bleaching agent from the half-stuff.

Intending competitors are requested to keep especially in view the circumstances in which the paper manufacture is carried on on the banks of the North Esk, in the county of Edinburgh. The merits of any suggestions which may be submitted will be regarded as being of greater value:—

1. By these being effected at moderate expense, and by their being applicable with as little interference as possible with the existing plant and mode of manufacture. And
2. By any substances, whether in suspension or solution, hitherto carried off in the stream, being demonstrated in practice, and by simple means to be capable of imparting fertility to arable or pasture land, or of being profitably applied otherwise.

Communications lodged in competition for prizes shall not have been patented, nor previously published, nor read before any other Society. Patented articles may, however, be exhibited and described.

For particulars as to the form in which communications should be sent, application should be made to John Beatson Bell, Esq., Secretary, 5, Hill-street, Edinburgh.

Manufactures.

RESPIRATORY APPARATUS.—Monsieur Galibert, of Paris, has invented an apparatus for affording a supply of atmospheric air to the lungs of persons working under water, or in places filled with noxious gases or smoke. The nose of the person is closed by a *pince-nez*, and a piece of horn or ivory, pierced with two holes, and shaped to some extent like the mouth, is inserted between the lips; adapted to each of these holes is a strong india rubber tube, capable of resisting pressure; these are fixed to the waist of the person, and then connected either with the outer air, if this can be arranged, or, if not, with an air-reservoir made of the entire skin of an animal, which may be carried on the back like a knapsack, and which contains a supply of air sufficient for a quarter or half an hour. The person using the apparatus should first apply the tongue to one hole and take a long inspiration, and then to the other hole during expiration. The apparatus, with air-reservoir, is intended to be employed by persons having occasion to remain some little time in wells, mines, drains, or in the midst of smoke. In some cases spectacles, specially calculated to protect the eyes, are added. When used under water, no air-reservoir is employed, but the tubes are made to communicate with the air. The inventor recommends its use for the purposes already referred to, as well as in cases where a total immersion of the body for some time in a bath is found desirable.

GREAT LENS.—A gigantic telescope is being made for the Imperial Observatory in Paris; and the great establishment of Saint Gobain has just completed for the new instrument a lens, of which the focal length is not given, but which is described as being seventy centimètres (28 inches) thick. It is six years since the lens was commenced, and it is said that the company presents it to the Observatory.

Commerce.

THE TEA DUTY.—Messrs. Capel and Co., in their circular, dated 8th May, say:—"We have had a fluctuating market since our last circular; the trade continued to buy freely at the improved rates quoted, until the morning of

the 17th ult., when an announcement in the *Times*, that a further reduction in the tea duties would form a feature of the Budget, led to more extensive purchases at a further advance of $\frac{1}{2}$ d. to 1d. per lb. When it became known that not only was this the case, but that the reduction was to the extent of 6d. per lb., there was considerable excitement, and on the Friday and Saturday offers to a large extent were made at prices showing a further rise of 1d. to $\frac{1}{2}$ d. per lb. The majority of holders, however, held out for still higher prices, and the business actually done was comparatively limited. Since then the excitement has subsided, and the prices now obtainable are only $\frac{1}{2}$ d. to 1d. per lb. above those of the 27th ult. The Government proposed that the reduction of duty should have taken place on the 6th instant, but the retail trade considered this a great hardship, owing to so short a notice after what they supposed to be a final settlement of the question in 1863; and, after great pressure, the Government have consented to postpone it until the 1st June. The postponement of the duty has also brought business to a partial stand, but when it comes fairly into operation we look to see a very large increase in consumption, as duty-paid tea will then be very cheap, and within the reach of a large portion of the population who have hitherto scarcely been consumers of the article."

Colonies.

PROPOSED DIVISION OF NEW ZEALAND.—In Auckland and Otago a movement for separation has sprung up. Auckland, shorn of its *prestige* as the capital city, and jealous of Wellington, demands to be constituted into a colony of itself, while Otago wishes to cut short the connection which exists between the northern and middle island. Auckland asks the Imperial Government to take the charge of native affairs, and pay the cost of doing so, while Otago wishes the north island in the future to bear alone the charges of the native war.

WELLINGTON CENSUS FOR 1865.—The total number of persons in the province, according to the present returns, appears to be 14,938, of whom 8,307 are males, and 6,631 females. In 1861 the total number was 12,566, thus showing an increase, during four years, of 2,372. The proportion between males and females is somewhat disturbed—the former being now more numerous. In 1861 the number of males was 6,626 against 5,940 females, while in 1865 the disproportion is greater. This in time may grow a serious evil, and demands a timely remedy in the shape of increased female immigration. The figures subjoined give some information as to the nationality of the population in the province. The English element is predominant, comprising one-third of the whole population; the Scotch rank next, but is much less prominent, being little more than one-tenth of the whole; while the Irish is still less. The remainder of the population are of New Zealand, Australian, Canadian, American, and European origin, those under the head of New Zealand figuring most largely in the returns. The advance in agricultural operations since 1861 has been very considerable; while in that year there were 55,313 acres under crop, the number now is 95,416 acres. The increase appears still more marked in going back farther still, the figures standing thus:—In 1855, 10,530 acres; in 1861, 55,313 acres, and in 1865, 95,416. The total number of acres fenced in is now 127,349. The increase in live stock has also been considerable. The present number of houses in the province is 2,900. The number of males in the province is 8,307; and of females, 6,631. The educational census shows that of those who cannot read (under 15 years of age) there are 3,173; above 15 years of age, 430; of those who can read (under 15 years of age), 1,064; above 15 years of age, 521; of those who can read and write (under 15 years of age, 2,258; above

15 years of age, 7,492. The number of acres under cultivation is 95,416.

NEW SOUTH WALES FINANCE.—At the opening of the Sydney Parliament, the Governor, referring to the finances of the state, said that during the year 1864 an additional deficit of £413,000 accrued, notwithstanding the many retrenchments made. The loss of crops from rust and inundations to the extent of at least half a million, and the loss of stock from disease and floods, by diminishing the purchasing power of the agriculturists, and other producers, very seriously cut down that portion of the revenue which is derived from customs' duties, while a great falling off in the sale of the waste lands of the Crown, deprived the Treasury of a large portion of the revenue ordinarily derivable from that source. He invited the members to look these financial difficulties in the face, and to aid the Government in providing the additional income, which was so urgently required to construct the public works, pay the debts, and maintain the credit of the colony.

COTTON AND SUGAR IN QUEENSLAND.—A local journal says that the failure of cotton cultivation in this colony may be attributed mainly to the absence of experience in its cultivation, a fatal belief having got possession of the public mind at the very outset that cotton would grow there without care or trouble. The contrary has been found to be the case, and it is now becoming a pretty general belief that no branch of cultivation requires more care or experience. The hopes of the colony as a cotton producer are now confined to the plantations of private individuals, most of the cotton companies having given it up. While, however, cotton, on the whole, has disappointed the planters, sugar cultivation has progressed in favour wherever tried during the last three years. Many agriculturists have planted quantities of cane during the past three or four seasons as an experiment, and the effect of severe droughts succeeded by floods for the last two years has convinced them that sugar cane is a certain crop and one offering every possible inducement for its cultivation. The fact has been well known that sugar-cane has thrived well in this colony during the last 15 years, but the absence of practical sugar manufacturers prevented any extent of cultivation until Captain Hope's enterprise in cane cultivation and the erection of sugar machinery at Cleveland, Moreton Bay, aroused public attention to the great value of its cultivation. The arrival in Queensland of a number of gentlemen from the West Indies, Mauritius, and other places, with a view of settling and investing their capital, has given confidence to capitalists desirous of investing in sugar plantations as a safe investment for colonial capital. Already upwards of 6,000 acres of land have been granted, under the Queensland sugar regulations, to gentlemen of high standing in this and other colonies.

Notes.

DISTRICT TELEGRAPH IN PARIS.—This service was established in January, 1864, and the cost of a minimum message was fixed at one franc. The number of messages was thus:—January, 577; February, 630; March, 745; April, 803; May, 808; June, 762; July, 784. On the 15th of August the cost of a message was reduced to half-a-franc, and the number of messages sent was as follows:—August, 2,500; September, 3,434; October, 6,849; November, 8,120.

PRESERVATION OF ICE IN SMALL QUANTITIES.—The importance of being able to keep small quantities of ice for various purposes, and especially in sick rooms for medical use, cannot be overrated. Dr. Schwarz has communicated the following simple method, which he has practised with success. He says, put the ice in a deep dish or jug, cover it with a plate, and place the vessel on a pillow stuffed with feathers, and cover the top with another pillow carefully, by this means excluding the external air. Feathers

are well-known bad conductors of heat, and in consequence the ice is preserved from melting. Dr. Schwarz states that he has thus preserved six pounds of ice for eight days. The plan is simple, and within the reach of every household.

FRENCH ACADEMY OF MORAL AND POLITICAL SCIENCE.—Dr. Milman, Dean of Saint Paul's, has been elected a corresponding member in the historical section of this branch of the Institut of France, in place of M. De Raumer, recently raised to the rank of Foreign Associate.

CITY HORTICULTURE.—There will be an exhibition of floral decoration of balconies and windows, at the Royal Horticultural Gardens, on Her Majesty's birthday, May 24. Also, on the first Monday in August, will be awarded prizes for the best plants and vegetables cultivated by soldiers in barracks, by sailors in homes by coast-guard men, and by workmen employed in her Majesty's dockyards. Also at a public fête, on the first Monday in September, will be awarded prizes for specimens of window-gardening among the working classes in metropolitan parishes.

ROYAL HORTICULTURAL SOCIETY.—The last scientific meeting was held on May 2nd, when the Rev. M. J. Berkeley spoke on certain species of clematis, &c., and Mr. Bateman on orchids and vaccinee.

SUBURBAN MUSEUMS.—On Saturday, the 6th inst., a meeting of gentlemen interested in the proposed establishment of metropolitan district museums of science and art was held at the South Kensington Museum. The meeting was convened by invitation of the Committee of Council on Education. Earl Granville presided, and among those present were Lord Ebury, Mr. Henry Cole, C.B., Secretary of the Science and Art Department, Lord H. Lennox, M.P., Mr. Ayrton, M.P., Mr. Beresford Hope, M.P., the Hon. Mr. Cowper, M.P., Mr. Locke, M.P., Mr. Bruce, M.P., Sir T. F. Buxton, M.P., Mr. Briscoe, M.P., Mr. Powell, M.P., Mr. Alderman Salomons, M.P., Mr. Tite, M.P., Mr. Harvey Lewis, M.P., &c. Earl Granville said the meeting had been called together merely for the purpose of discussing what should be done with the present iron building. When it was proposed to get rid of it a suggestion was made that, instead of selling it as old materials, it might be more usefully disposed of by presenting it, at a nominal price, to the different districts of the metropolis so as to form temporary local museums. He had very little doubt but that, when once these were established, the people of the several districts would soon make efforts to procure handsome buildings of their own. Considerable discussion took place, the opinion being expressed that district museums, particularly if kept open in the evening would be of great value to the working classes. It was, explained that the Government proposed to accommodate three districts by dividing the building into three parts, a plan which received the approval of Mr. Tite, M.P., and others. A vote of thanks having been passed to Lord Granville, his lordship, in acknowledging the compliment, said the Science and Art Department were not by any means desirous of establishing a monopoly at South Kensington, but were most anxious to see district museums supported wherever they would be useful and agreeable to the inhabitants.

EDUCATION AND CRIME.—The large number of convicts at Toulon offers a good opportunity of noting the relation between cultivation and good conduct. It appears that there are at present 2,218 prisoners in the *Bagne* of Toulon, of whom 1,330 can neither write nor read; 649 can barely do either; 208 read and write imperfectly; and only 31 possess superior education.

Correspondence.

TESTING AND WELDING BOILERS.—SIR,—In the very able paper of Mr. Paget, on steam boilers, he alludes to the various modes of testing their strength. With regard to the disadvantage of a pulsating action, I think there can

be no doubt, whether arising from the alternating action of the cylinders or from the strokes of a ram. The simple mode in the latter case to moderate the evil would be to use a ram with three strokes nearly neutralising each other; and the water should as nearly as possible be in the condition of heat induced by steam. If cold water be used approaching to frost, the metal will be rendered brittle and the joints leaky. With moderately-heated water the metal will be tougher and the joints tighter. As regards the general structure of boilers, it is radically vicious, and will continue to be so just as long as the principle of rivetting continues in use. No truth can be clearer than that the metal should be all of one equal thickness, at least where in contact with fire, and that thickness must not exceed the free action of heat in passing through it. If it be too thick, the metal will simply burn away till reduced to the right thickness, in those parts exposed to the fire, and thus the thickness will vary and the strains will be unequal. These conditions will limit the pressure that can be safely put on the boiler. In the application of heat to raise steam there can be no doubt that flame is the best method. We all know how rapidly a sheet of paper will boil water in a tea kettle, and therefore it is that, whenever we can get petroleum cheap enough and use it rightly it will be the best fuel, as it may be made to cover a larger surface with direct heat. But to do it perfectly we must have all the heating surface of equal thickness, a condition which cannot be attained till we get rid of the folded surfaces essential to rivetting. There is no apparent difficulty in welding all the seams of a boiler, whether of copper, iron, or steel. Welding is simply a condition of rendering the clean metal surfaces pasty, by heat, and then inducing perfect contact by pressure, uniting thoroughly the softened portions. That can only be done by the flame heat covering all portions of the surfaces to be united, without any uncombined oxygen getting access to them, for if it does, scaling will ensue; and when scale occurs the effect will be like that of dry flour between bakers' rolls—contact without union. Nor will either percussion or pressure drive out this scale, but on the contrary will drive it in. Now suppose two clean edges of a piece of welding metal to be placed an eighth or quarter of an inch apart from each other, and that they are held in position by a box of fire-clay, fitting close to all parts except those intended for union, with entrances and exits, or "gates," as technically termed by the founders, allowing a free passage of air through the joint; if then carburetted hydrogen gas and atmospheric air, mixed in the right proportions for combustion, in a chamber under pressure, be forced through the joint, burning, the exposed surfaces of the joint will be made pasty or partially melted; and if pressure, hydraulic or other, be brought to bear to force them into contact, there will be homogeneous union without scale, because there will be no free oxygen to cause the scale, as in the ordinary mode, by irregular jets, and blows of a hammer; and there is no apparent reason why boilers, or any other weldings, should not be produced in the same manner, for the flow of the burning gas may be continued without intermission for any required time. My conviction is that this method will prove to be the true one for producing boilers without seams and rivets and of equalised thickness.—I am, &c.,

W. BRIDGES ADAMS.

THE WEAR AND TEAR OF STEAM BOILERS.—SIR,—Having read Mr. F. A. Paget's able and useful paper on "The Wear and Tear of Steam Boilers," published in your number for April 28th last, and in particular his account of the furrowing and pitting of boiler plates, I am glad to see that he gives what, in my opinion, are the true causes of these forms of destructive action. My object in now addressing you is to state that, in 1860, I published, at some length, my observations on this subject, in my work on the "Recent Practice in the Locomotive Engine," where I advanced precisely the same views of the causes of furrowing and pitting as those now

advocated by Mr. Paget; and, so far as I am aware, this was the earliest publication of the true causes. If I am in error, I shall be glad to be set right. Meantime, if you will allow me, I will shortly quote from "Recent Practice" my conclusions on the furrowing and pitting of boiler plates:—

"Probably the most important practical inference to be drawn from the tests of the strength of rivetted joints, is the explanation they supply of the failure, hitherto unexplained, of boiler plates, not at the joints, but in their neighbourhood. We are aware that electrical and galvanic action are freely ad-duced in explanation. But these words have two meanings:—they mean electricity and galvanism; and they mean ignorance and mystery. It is known that boilers fail by corrosive and other agencies eating into the plates on the inside, pitting and furrowing the surface. The pitting of the metal is readily explained by the presence of chemical agents in solution in the water, and the known inequality of substance of iron plates and bars, in consequence of which the metal is gradually but unequally separated and dissolved; and probably a weak galvanic circuit may be established between the iron shell and the brass tubes, accelerating the process of dissolution. But this explanation does not meet the frequent case of a straight continuous furrow, cut like a groove, upon the surface. Furrows are observed to be formed parallel to, and close to, the rivetted joints. Not in any case, that we are aware of, have they been found at any notable distance from a rivetted joint, nor otherwise than parallel to one. The inference is inevitable, that there is a relationship betwixt them; and our conviction is, that the alternate tension and relaxation of the plates at the joints, as the steam is got up and let down, are attended by an alternate distortion, incipient it may be, and resumption of the normal form, a bending and unbending of the plate on each side of the joint; in consequence of which the texture of the metal is gradually loosened in lines near to, and parallel to, the joint, and it is thus laid open to corrosive action. On this interpretation, the commencement of a groove or furrow, establishing a weak place, and concentrating the action there, would suffice to extend and deepen it to the dangerous limits occasionally announced by explosion. The weakness attendant on lap joints is strikingly exemplified in the lap welded joint when subjected to extreme tension: the tensile strength, though the metal at the weld is perfectly solid and fully as strong in itself as the body of the plate, is much below that due to the regular section of the plate. Here there is no elementary weakness in the reduction of metal by rivet-holes; the inferiority of strength arises solely from the bending of the plates on both sides of the lap, and the overstraining of the fire-box, in the endeavour to attain to the position of stability. . . . The furrowing of lap-jointed plates reads an important lesson on the real and intimately practical value of direct connection and direct action in exerting, transmitting, or resisting forces. That the furrowing of plates at the rivetted joints results from the indirectness of the strain of the steam pressure, is rendered still more probable by the analogous furrowing which results from reciprocating strains of another kind. In the more ancient classes of engines, in which the cylinders are fixed to, and work from, the smoke-box plates, the alternate forward and backward strains by the steam-pressure on the piston have been observed to weaken, and to subject to corrosion and leakage, the substance of the plate along the edge of the angle-iron at the junction with the barrel. In further corroboration of this doctrine, Mr. Colburn states that he is not aware that any accidents from furrowing of boiler plates have taken place in the United States; and we believe that their immunity from accidents arising from this source is to be ascribed to the use of very thin boiler plates, quarter to five-sixteenths of an inch thick." (Pages 15 and 16.)

In addition, my explanation of the destructive action of unequal expansion of the fire-box of locomotives and the shell, upon the stay bolts, in straining them laterally beyond the limits of elasticity, and thus permanently weakening them, was published at the same time ["Recent Practice," p. 16 and 17], and, I think, anticipates all that Mr. Paget has just written on the same subject. I trust you can afford space for this letter, for in a paper like Mr. Paget's, elaborately based upon published authorities, it is of some importance, I think, that references, inadvertently incomplete, should be supplemented.—I am, &c.,

D. K. CLARK.

11, Adam-street, Adelphi, May 9th, 1865.

ON COLONIZATION; ITS ASPECTS AND RESULTS.—SIR,—The late hour to which the discussion was protracted on the evening of the 3rd inst., precluded my replying to one or two remarks of the speakers, and compel me reluctantly to still further trespass on your space. The Chairman inclined to think that I consider that mechanical contrivances tend to cheapen wages, whereas the contrary will be evident by reference to page 407, at the foot of the first and head of the second columns, where I give the rationale, as I conceive, of the increase in wages caused by machinery. Professor Levi drew attention to the fact of so many persons emigrating to the United States in one year as contrasted with Canada. Two circumstances should be borne in mind in reference to this matter. Of the large number of fifty thousand emigrants, thirty-three thousand were Irish, the poorest class of emigrants; by the wealthier English, Australia, which is four times as expensive to reach, was preferred; and of the shrewd Scotch, while only 1,000 went to the States, 2,500 went to Canada, and upwards of 8,000 to Australia. We must, therefore, take into account the cheapness of getting to America, and the fact that the United States can scarcely be regarded as widely differing from our own country in laws and habits, before we come to the conclusion that the nature of the Government has nothing to do with emigration. Almost as much money was sent from America as would pay the passage of all the emigrants. With reference to Mr. Torrens's remarks, I may observe that the English army is composed of some 150,000 men, of which 50,000 are kept in England, and 100,000 are distributed throughout our colonies and dependencies. To the effect, therefore, of what bone and muscle may be necessary to maintain 100,000 efficient men abroad, the home country is exhausted; and as each man costs about £30 a-year, the money abstracted from the country on this account amounts to £3,000,000 annually. With respect to the colonies being represented in the Home Parliament, I confess I once held the opinion of its desirableness, but when I find how little even the important subject of India can be made to interest the English Parliament, I must say I tremble for the attention which would, under the proposed plan, be given to the hon. Member for Vancouver's Island or Labuan. With reference to cotton, I have only to observe that if, in the hour of our need, we have drawn two-fifths of our supply from our own dependencies, that is a large proportion. Whether India can grow cotton to compete with America I am unable to say. It appears to me to be a question of climate, soil, seed, and treatment, and I should prefer seeing a peaceful rivalry to any other condition of matters. I may add that it is not the South who have prevented us having cotton, but the North; and I believe I only echo the statement of every Englishman (from the Premier downwards) in severely reprobating the conduct of Butler. Mr. Hill somewhat hastily concluded that my views on transportation are theories. Twice I visited New South Wales in its convict days; twice I resided for some time in Van Dieman's Land; and it so chanced that I lived for two years with the only unofficial family who ever remained on Norfolk Island for any period while in its worst days. My opinions are based on personal observation. I have known expirés and ticket men, in both New South Wales and Van Dieman's Land, whose cheques would be honoured for thousands, whose acceptances would be discounted by the most scrupulous bank, who properly attended to all the duties of life, educating their children, serving on juries side by side with freemen as fellow citizens, regularly attending divine service, &c. Now what do I see at home? Garotters, burglars of the most serious character; and almost every daily paper contains accounts of trials in which the worst class of prisoners are stated to have previous convictions recorded against them. I cannot speak as to Ireland. I am only too happy to hear that Ireland is satisfied with her convicts; England certainly is not. Mr. Hill did not explain how he would act upon Bacon's dictum, and pre-

vent men "multiplying their depravity." It rather seems to me that the difference between us is mainly this—Mr. Hill would allow the race to propagate surrounded by their old vicious companions, and without room to grow out into purity; whereas I would allow them space and opportunity to return to obedience to the laws of nature and man. I am rather surprised that Mr. Hill should detect any similarity between the rock-bound, harbourless Norfolk Island, containing some fourteen square miles, with its masses of closely-huddled male convicts, and the Falkland Islands, containing some 7,000 square miles, with harbours and ports, where I proposed to disperse the convicts on small farms.—I am, &c., W. STONES.

MEETINGS FOR THE ENSUING WEEK.

- MON. ...British Architects, 8.
Asiatic, 8.
Royal United Service Inst., 8½. Major C. H. Owen, R.A., "The Present State of the Artillery Question."
TUES. ...Society of Arts, 8. Cantor Lectures. Dr. F. Crace Calvert, "On some of the Most Important Chemical Discoveries made within the last two years." (Lecture VI.)
Civil Engineers, 8. Mr. Edward Fletcher, "On the Maintenance of Railway Rolling Stock."
Statistical, 8. Prof. W. S. Jevons, M.A., "On the Variation of Prices and the Value of the Currency since 1782."
Pathological, 8.
Anthropological, 8. The Bishop of Natal, "Missionary Work in Africa."
Royal Inst., 4. Prof. Frankland, "On Organic Chemistry."
R. Horticultural, 3. Scientific Meeting.
WED. ...Society of Arts, 8. Mr. Zerah Colburn, "On the Manufacture of Encaustic Tiles and Ceramic Ornamentation by Machinery."
Pharmaceutical, 11. Annual Meeting.
R. Society of Literature, 4½.
THURS. ...Royal, 8½.
Antiquaries, 8.
Chemical, 8.
Numismatic, 7.
Philosophical Club, 6.
Royal Inst., 4. Prof. Frankland, F.R.S., "On Organic Chemistry."
FRI. ...Philological, 8. Annual Meeting.
Royal Inst., 8. Mr. Wm. Huggins, "On Stellar Physics and Chemistry."
SAT. ...Royal Inst., 4. Mr. Alexander S. Herschel, "On Meteorology."

PARLIAMENTARY PAPERS.

SESSIONAL PRINTED PAPERS.

Delivered during the Easter Recess.

- Par. Numb.
64. Bills—Theatres, &c.
105. " Sewage Utilization (as amended by the Select Committee).
100. " Land Drainage Supplemental.
106. " Lancaster Court of Chancery.
109. " Police Superannuation.
111. " Private Bill Costs (Lords Amendments).
101. " Roads and Bridges (Scotland).
93. " Grand Juries (Ireland).
107. " Oxford University (Vinerian Foundation).
3 (300). Railway and Canal, &c., Bills—Board of Trade Reports Part 300.
65 (vi). Committee of Selection—Seventh Report.
47. East Indian (Bootan)—Papers.
140. Mines—Return (Corrected Copy).
145. Tithe Commutation—Return.
79. East India (Gold Currency)—Resolution.
137. Works and Public Buildings—Abstract Account.
179. Rochdale and other Waterworks Reservoirs—Reports.
182. War Office (Superannuations)—Return.
194. Immigrants and Liberated Africans—Return.
198. Railways (Session 1865)—Board of Trade Report.
193. Salmon Fisheries (England and Wales)—Fourth Annual Report of Inspectors.
158. Criminal Offenders (Scotland)—Abstract of Tables.
161. Increase and Diminution (Public Offices)—Abstract of Accounts.
163. Church Building Acts, &c.—Return.
170. West Coast of Africa—Report.
187. Army Chaplains, &c.—Detailed accounts.
197. Chelsea Bridge—Return.
151. Agricultural Parishes—Return.
199. Telegraphic Communication (India, &c.)—Correspondence and Papers.
82. Steam Transports (England and India)—Specifications.
110 (1). Revenue Expenditure, &c.—Returns.

159. Steam Transports (England and India)—Reports and Correspondence.
 178. Open Spaces (Metropolis)—First Report, &c., of the Select Committee.
 191. Benefices (Metropolis)—Returns.
 90 (iii). Civil Service Estimates (Class III).
 192. Public Offices (Site and approaches)—Plan.
 173. Patent Office—Return.
 91. Revenue Departments—Estimate.
 92. Post Office Packet Service—Estimate.
 174. Cawood Charities—Report.
 175. Bakehouse Regulation Act Reports.
 183. Post office Savings Banks—National Debt.
 190. St. James Garlichithe, &c., Rectories—Minutes, &c.

By Command—Church Estates Commissioners—Fourteenth Report, &c.
 „ Ecclesiastical Commissioners for England—Seventeenth Report, &c.
 „ Foreign Statistics—Statistical Tables, Part IX.
 „ Convention of Geneva—Accession of the British Government.
 „ Sewage of Towns, &c.—Third Report of Commission.
 „ New Zealand—Further Papers.

Delivered on 25th April, 1865.

169. Isle of Man Disafforesting Act—Copies of Papers and Documents.

Delivered on 26th April, 1865.

168. Bill—Local Government Supplemental (No. 2).
 153. Customs Out-Door Officers—Memorials.
 188. Recorder of Galway—Papers.
 201. Coast Guard Service—Detailed Accounts.
 204. War Office (Temporary Clerks)—Return.

Delivered on 27th April, 1865.

112. Bill—Waterworks.
 90 (i). Civil Service Estimates (Class I.).
 162. Superannuations (Public Officers) Account.
 208. Register of Sasines (Edinburgh)—Returns.

Delivered on 28th April, 1865.

114. Bills—Railways Clauses.
 116. „ Locomotives on Roads (as amended in Committee).
 118. „ Local Government Supplemental (No. 3).
 196. East India (Dhar)—Further Correspondence.
 210. Land Registry—Returns.
 219. Army—Statement.

Patents.

From Commissioners of Patents Journal, May 5th.

GRANTS OF PROVISIONAL PROTECTION.

- Abdominal and scrotal bandage—1016—A. Stewart.
 Boilers, apparatus for feeding—1062—R. A. Frooman.
 Boots and shoes, elastic binders for—1050—W. E. Newton.
 Boots and shoes, flexible spring waist for—1034—B. W. L. Nicoll.
 Buildings, apparatus for making communications from one part to another—1143—J. J. Parkes.
 Cigar cutter—1139—H. C. Butcher.
 Corn, &c., screening, sifting or riddling—1105—W. Beaven.
 Cues, rests or supports for—1048—G. Jackson.
 Dress, fastening for articles of—1165—C. W. Heaven.
 Distilling hydrocarbons, apparatus for—1076—J. Dougan.
 Electricity, communicating intelligence by means of—1088—R. A. Jones and J. Hedges.
 Engines, locomotive—48—C. de Bergue.
 Fabrics, securing buttons to—1151—G. Davies.
 Felts, &c., apparatus for printing—1155—J. Wilkinson, jun.
 Fibres, threads, &c., preparing—1169—R. A. Brooman.
 Fibrous materials, machinery for combing, &c.—1084—T. Whitehead and N. Nussey.
 Fibrous substances, preparing and spinning—1125—E. Lord.
 Fire-places and flues—989—E. Welch.
 Fire-arms—1046—T. J. Mayall.
 Fire-arms, breech-loading—1071—A. Henry.
 Fire-arms, breech-loading—1092—G. T. Bousfield.
 Glass, protecting designs on—1111—D. S. Buchanan.
 Hoop iron, manufacture of—4063—T. Bennett.
 Human hair, machinery for cutting—973—R. Maynard.
 India rubber, substitute for—1068—W. Clark.
 Iron, bar used in puddling—968—G. W. Dyson.
 Iron, manufacture of—1153—J. N. Brown and T. D. Clare.
 Iron safes and strong rooms—1056—J. Chubb.
 Lace or net fabric, articles of—1129—C. J. and J. A. Keenan.
 Ladies' skirts—1060—J. C. A. Henderson.
 Land, ploughing and tilling—1123—C. Hall.
 Liquids, pouring and decanting—1149—N. Sibly.
 Locomotive engines, &c., construction of—916—G. R. Stephenson and G. H. Phipps.
 Locomotives, compensating wheel to be used with—1022—J. J. Myers.

- Looms—1032—A. Turner.
 Looms—1070—M. Smith.
 Looms—1086—J. E. H. Andrew.
 Madder, treatment of—538—P. A. Le Comte de Fontaine-Moreau.
 Matches, receptacles for—1121—G. G. W., and J. Betjemann.
 Metallic rods, tapering the ends of—976—E. H. Newby.
 Metal plates, machine for straightening, bending, &c.—1082—J. Todd.
 Navigable balloons—930—P. Haenlein.
 Oiling cans—1119—G. Whillock.
 Ores, &c., furnaces for smelting—942—H. Brook, J. Eastwood, and G. Brook, jun.
 Penholders—1147—W. E. Newton.
 Photographic cameras—1171—J. A. Rowland.
 Power engine—1052—H. Leonhardt.
 Pulley blocks, iron sheaves and bushes for—1085—J. Gardner, R. Lee, G. H. Wain, and S., C., and S. Hargrove.
 Pumps—1099—M. Houssepian.
 Railways, permanent way of—1131—W. Bunge.
 Railway trains, communication between the passengers and guard of—1078—G. W. Garrod.
 Railway trains, communication between the passengers and guard of—1097—D. Hancock and T. Evans.
 Railway trucks, &c., means of covering—1090—W. Riddell.
 Rotating brushes—1038—J. Haworth.
 Ships of war, &c., construction of—1107—H. Caudwell.
 Ships, steering—1157—W. Elder.
 Solutions, apparatus employed in the concentration of—872—W. Walsh.
 Spindles, &c., apparatus for lubricating—1060—J. Rippon.
 Spinning, spools or bobbins to be used for—1127—J. H. Wilson.
 Steam boilers, safety apparatus for—1066—J. M. Courtauld.
 Suction and blast, method of applying—1028—R. A. Brooman.
 Superphosphates of lime, manufacture of soluble and assimilable—1161—W. Clark.
 Swimming, shoe for facilitating the art of—1145—A. Atkins.
 Taps or stop cocks—1101—W. Clark.
 Tubes, fitting of surface condenser—1133—A. V. Newton.
 Umbrella and parasol tip fasteners—833—R. Lublinski.
 Water and gas, pipes for conveying—1058—C. F. Cotterill.
 Waterproof fabrics, manufacture of—1159—J. C. Wickham and A. E. Deiss.
 Wet gas meters—1072—T. Newbigging and A. Hindle.
 Wheels—1024—S. Wright.
 Wood, taking impressions from the grain of—1117—W. Scarratt and W. Dean.
 Wool, treatment of—1042—H. Sikes and G. Jarman.
 Wringing machines—922—H. Lewis.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

- Pumps—1210—C. E. Herpst.
 Silks, &c., apparatus for spinning—1202—P. A. Le Comte de Fontainemoreau.

PATENTS SEALED.

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|-------------------------------------|---------------------------------|
| 2716. W. Davies and G. and W. Cate. | 2794. J. McCall & B. G. Sloper. |
| 2770. C. Garton. | 2795. T. L. and R. Boote. |
| 2771. W. K. Hall. | 2803. W. Clark. |
| 2780. S. Dixon. | 2815. J. Thorne. |
| 2788. J. A. Manning. | 2817. J. Keats and W. S. Clark. |
| 2790. R. B. Cooley. | 2857. R. Holiday. |
| | 2859. R. Allinson and H. Lea. |

From Commissioners of Patents Journal, May 9th.

PATENTS SEALED.

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| 2807. J. Kinniburgh. | 2858. M. Destrem. |
| 2811. W. C. Thurgar and R. A. Ward. | 2884. M. Henry. |
| 2816. H. and E. Sutherland. | 2891. J. Phillips. |
| 2821. F. A. Papps. | 2902. W. Martin. |
| 2828. T. Jones. | 2946. W. Ward. |
| 2832. G. E. Noone. | 3026. W. Clark. |
| 2836. R. Harlow and W. Jolley. | 3056. H. Wilson. |
| 2842. M. Henry. | 3081. W. B. Adams. |
| 2848. P. Lachéz. | 3086. H. Taylor. |
| 2850. J. Bullough. | 93. A. G. Lock. |
| 2852. A. Wall. | 491. I. Pariente. |
| | 753. A. V. Newton. |

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

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| 1345. A. Morel. | 1376. W. Riddle. |
| 1364. N. Wood and J. Stockley. | 1347. P. Chenaillier. |
| 1307. H. Juhel. | 1358. E. Bourdon. |
| 1321. J. and T. Mellodew, and C. W. Kesselmeier. | 1389. L. D'Aubreville. |
| 1342. B. Cooke. | 1343. T. Cabourg. |
| 1360. P. H. Colomb. | 1362. T. H. Hopwood. |
| 1328. H. Allman. | 1369. G. T. Bousfield. |
| 1337. J. Roscoe. | 1378. W. Southwood. |
| 1340. J. H. Johnson. | 1381. C. Lungley. |

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

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| 985. J. Taylor. | 999. W. S. Hollands. |
| 992. W. E. Newton. | 1111. J. Brown. |